INSTALLATION RESTORATION PROGRAM
PHASE I: RECORDS SEARCH
WHITEMAN AFB, MISSOURI

Prepared For

UNITED STATES AIR FORCE
STRATEGIC AIR COMMAND
Deputy Chief of Staff
Engineering and Services
Offutt AFB, Nebraska 68113

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The identification of hazardous waste disposal sites at military installations was directed by Defense Environmental Quality Program Policy Memorandums. Phase I constitutes a records search to determine the potential, if any, for off base imgration of toxic or hazardous wastes as a result of past operations and disposal activities. The final report reveals no direct evidence of off base pollution migration. However, it has been recommended that several areas receive additional attention to determine if pollution migration exists.

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EXECUTIVE SUMMARY

The Department of Defense (DOD) has developed a program to identify and evaluate past hazardous material disposal sites on DOD property, to control the migration of hazardous contaminants, and to control hazards to health or welfare that may result from these past disposal operations. This program is called the Installation Restoration Program (IRP). The IRP has four phases consisting of Phase I, Initial Assessment/Records Search; Phase II, Confirmation/Quantification; Phase III, Technology Base Development; and Phase IV, Operations/Remedial Actions. Engineering Science (ES) was retained by the United States Air Force to conduct the Phase I, Initial Assessment/Records Search for Whiteman AFB under Contract No. F08637-83-R0102.

INSTALLATION DESCRIPTION

Whiteman Air Force Base is located in west-central Missouri, about nine miles east of Warrensburg, 22 miles west of Sedalia, and 65 miles southeast of Kansas City. The base is bordered by agricultural land on the south and east, by Knob Noster State Park and low density residential areas on the west, and by the town of Knob Noster on the north.

The base comprises 4,676.47 acres of U.S. government-owned land. Remote installation facilities consist of the following, which includes U.S. govenment-owned, leased, and easement lands:

- Warrensburg, Missouri Repeater Site. . . . 8.54 acres
- Sedalia, Missouri Repeater Site. . . . . . 6.89 acres
- Appleton City, Missouri Repeater Site. . . 6.89 acres
- TVOR Site. . . . . 0.23 acres
- ILS Glide Slope. . . . . 0.75 acres
- 351st Strategic Missile Wing (SMW) sites . 20,115 acres

Whiteman Air Force Base was constructed and began operations in 1942. The base served as a training site for glider tactics and paratroopers. Assigned aircraft included Douglas C-46s and C-47s and Waco CG-4A gliders. Sedalia Army Air Field served as a transition point for C-46 and C-47 crews after World War II until 1947, when it was placed in inactive status. In August 1951 the base was reactivated as part of the Strategic Air Command (SAC). The 340th Bombardment Wing at Whiteman was equipped with the Boeing B-47 Stratojets and with KC-97 tankers during the 1950's. In June 1961, the Department of Defense announced that Whiteman had been chosen as the location of the fourth Minuteman ICBM wing. Construction of the sites was initiated in 1962 and completed in June 1964. Since the mid-1960s, the base has maintained the 351st Strategic Missile Wing (SMW).

ENVIRONMENTAL SETTING

The environmental setting data for Whiteman AFB indicate that the following elements are relevant to the evaluation of past hazardous waste management practices.

1. The mean annual precipitation is 38.4 inches and net precipitation is calculated to be minus 3.2 inches.
2. Flooding may be a temporary local problem at the base because of drainage restrictions during heavy rainfall events.
3. Base surface soils are typically a thin mantle of fine-grained, slow draining, and low permeability materials. Sandy layers occasionally occur as lenses.
4. An ephemeral shallow aquifer (probably perched seasonally) likely underlies the base and is present at or near land surface. The depth to water in this shallow unit is not known. This aquifer is not known to be a source of water supplies.
5. The base is located in a recharge zone for the shallow unit.
6. Two aquifers of regional importance (Ordovician and Cambrian systems) underlie the base at great depth (800+ feet). They probably receive recharge from areas in which they are located close to land surface, east of the installation in Pettis County.

7. Local municipal water distribution systems and Whiteman AFB utilize the deep aquifers to obtain water resources. It is not known from which aquifer(s) local domestic or agricultural consumers derive water supplies.
8. Water obtained from the deep aquifers has been reported to be of good quality.
9. Surface water quality exceeds Missouri State Standards on occasions for several parameters, including oil and grease, phenols, ammonia, metals, and pesticides.
10. The prairie chicken has been identified as a threatened or endangered species on base.

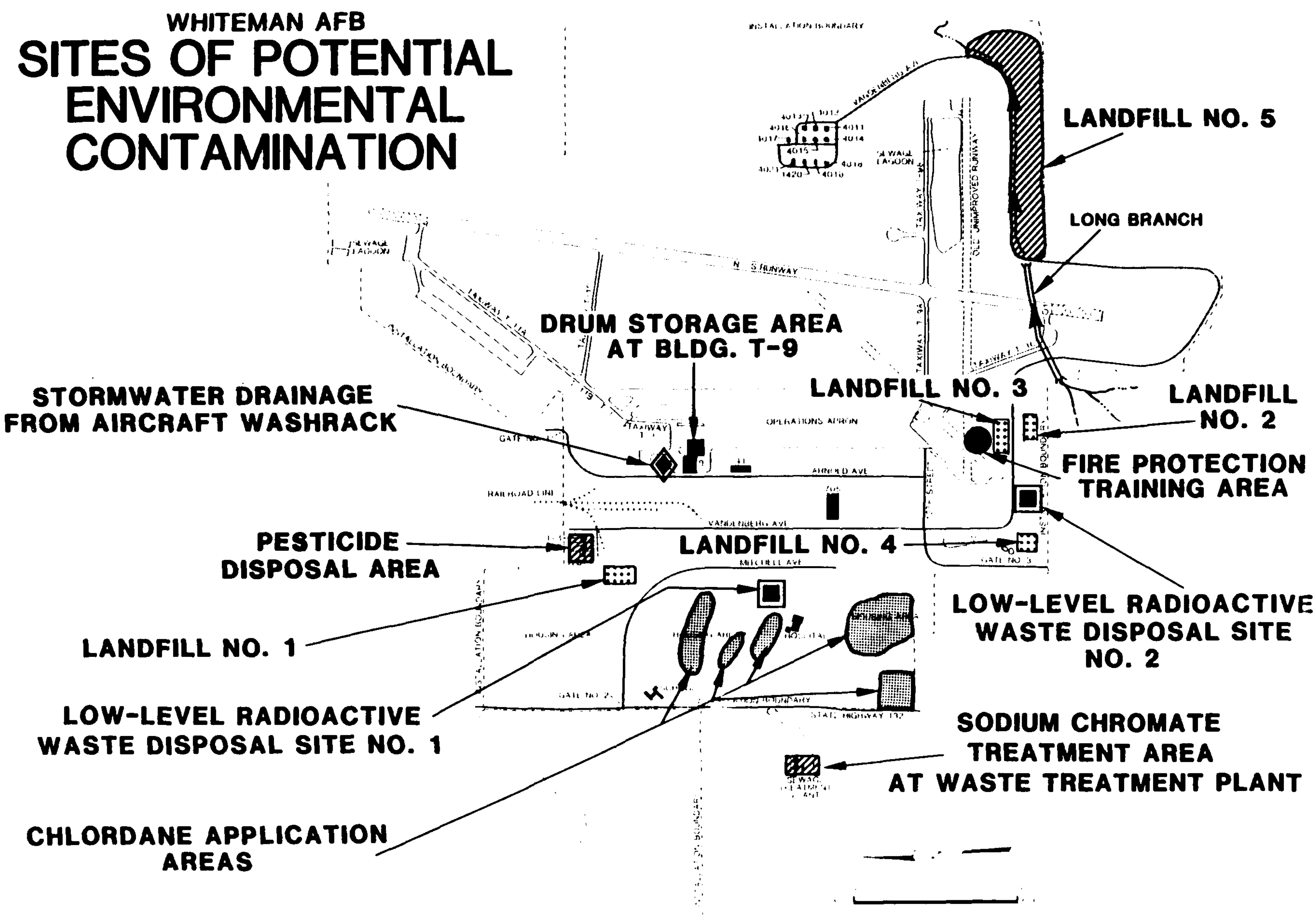
METHODOLOGY

During the course of this project, interviews were conducted with base personnel (past and present) familiar with past waste disposal practices; file searches were performed for past hazardous waste activities; interviews were held with local, state, and federal agencies; and field and aerial surveys were conducted at suspected past hazardous waste activity sites. Thirteen sites located within Whiteman AFB boundaries were identified as potentially containing hazardous contaminants and having the potential for migration resulting from past activities (Figure 1). These sites have been assessed using a Hazard Assessment Rating Methodology (HARM) which takes into account factors such as site characteristics, waste characteristics, potential for contaminant migration, and waste management practices. The details of the rating procedure are presented in Appendix G and the results of the assessment are given in Table 1. The rating system is designed to indicate the relative need for follow-on action. The sites have also been reviewed with regard to future land use restrictions.

FINDINGS AND CONCLUSIONS

The following conclusions have been developed based on the results of the project team's field inspection, review of base records and files, and interviews with base personnel.

FIGURE 1



SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS

TABLE 1
SITES EVALUATED USING THE
HAZARD ASSESSMENT RATING METHODOLOGY
WHITEMAN AIR FORCE BASE

Rank	Site	Operating Period	Final HARM Score
1	Chlordane Application Areas	1980 - present	65
2	Fire Protection Training Area	1940's - present	63
3	Landfill No. 5	1972 - 1977	62
4	Excess Pesticide Disposal Area	1950's - present	59
5	Sodium Chromate Treatment Area At Waste Treatment Plant	1980 - 1981	56
6	Drum Storage Area At Bldg. T-9	1960's - present	51
7	Storm Water Drainage From Aircraft Wash Rack	1950's - present	46
8	Landfill No. 1	1940's	42
9	Low-Level Radioactive Waste Disposal Area No. 1	1952 - 1957	41
10	Low-Level Radioactive Waste Disposal Area No. 2	1957 - 1959	36
11	Landfill No. 2	1950's	35
12	Landfill No. 3	late 1940's - mid 1950's	34
13	Landfill No. 4	1957 or 1958	34

Each of the six sites listed below was ranked using the HARM system and was determined to have a sufficient potential for environmental contamination to warrant some degree of follow-on investigation.

Chlordane Application Areas
Fire Protection Training Area
Landfill No. 5
Excess Pesticide Disposal Area
Sodium Chromate Treatment Area at Waste Treatment Plant
Drum Storage Area at Building T-9

RECOMMENDATIONS

A program for proceeding with Phase II of the IRP at Whiteman AFB is presented in Chapter 6. The Phase II recommendations are summarized as follows:

Chlordane Application Areas - Conduct soil borings; extract by EP toxicity procedure and perform analysis on extracts.

Fire Protection Training Area - Conduct soil borings; extract by EP toxicity procedure and perform analysis on extracts.

Landfill No. 5 - Sample Long Branch, perform analysis on water samples.

Excess Pesticide Disposal Area - Conduct test borings; extract by EP toxicity procedure and perform analyses on extracts.

Sodium Chromate Treatment Area at Waste Treatment Plant - Sample surficial soils; extract by EP toxicity procedure and perform analyses on extracts.

Drum Storage Area at Building T-9 - Conduct test borings; extract by EP toxicity procedure and perform analyses on extracts. Also perform one-time grab sampling of storm drain.

SECTION 1

INTRODUCTION

BACKGROUND AND AUTHORITY

The United States Air Force, due to its primary mission, has long been engaged in a wide variety of operations dealing with toxic and hazardous materials. Federal, state, and local governments have developed strict regulations to require that disposers identify the locations and contents of past disposal sites and take action to eliminate hazards in an environmentally responsible manner. The primary Federal legislation governing disposal of hazardous waste is the Resource Conservation and Recovery Act (RCRA) of 1976, as amended. Under Section 6003 of the Act, Federal agencies are directed to assist the Environmental Protection Agency (EPA) and under Section 3012, state agencies are required to inventory past disposal sites and make the information available to the requesting agencies. To assure compliance with these hazardous waste regulations, DOD developed the Installation Restoration Program (IRP). The current DOD IRP policy is contained in Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, dated 11 December 1981 and implemented by Air Force message dated 21 January 1982. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the Installation Restoration Program. DOD policy is to identify and fully evaluate suspected problems associated with past hazardous contamination, and to control hazards to health and welfare that resulted from these past operations. The IRP will be the basis for response actions on Air Force installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, Executive Order 12316, and 40 CFR 300 Subpart F (National Oil and Hazardous Substances Contingency Plan). CERCLA is the primary legislation governing remedial action at past hazardous waste disposal sites.

PURPOSE AND SCOPE OF THE ASSESSMENT

The Installation Restoration Program has been developed as a four-phased program as follows:

Phase I	- Initial Assessment/Records Search
Phase II	- Confirmation/Quantification
Phase III	- Technology Base Development
Phase IV	- Operations/Remedial Actions

Engineering-Science (ES) was retained by the United States Air Force to conduct the Phase I Records Search at Whiteman Air Force Base under Contract No. F08637-83-R0102. This report contains a summary and an evaluation of the information collected during Phase I of the IRP. The land areas included as part of the Whiteman AFB study are the following, which include U.S. government-owned, leased and easement lands:

Main Base Site	4,676.47 Acres
Warrensburg, Missouri Repeater Site	8.54 Acres
Sedalia, Missouri Repeater Site	6.89 Acres
Appleton City, Missouri Repeater Site	6.89 Acres
TVOR Site	0.23 Acres
ILS Glide Slope	0.75 Acres
351st Strategic Missile Wing (SMW) Sites	20,115 Acres

The goal of the first phase of the program was to identify the potential for environmental contamination from past waste disposal practices at Whiteman AFB, and to assess the potential for contaminant migration. The activities that were performed in the Phase I study included the following:

- Review of site records
- Interviews with personnel familiar with past generation and disposal activities
- Survey of types and quantities of waste generated

- Determination of estimated quantities and locations of current and past hazardous waste treatment, storage, and disposal activities
- Definition of the environmental setting at the base
- Review of past disposal practices and methods
- Collection of pertinent information from federal, state, and local agencies
- Assessment of the potential for contaminant migration
- Development of recommendations for follow-on actions

ES performed the on-site portion of the records search during December, 1983. The following core team of professionals was involved:

- E. H. Snider, P.E., Chemical Engineer and Project Manager, 7 years of professional experience.
- T. R. Harper, Environmental Scientist, 1 year of professional experience.
- J. R. Absalon, Hydrogeologist, 9 years of professional experience.
- R. J. Reimer, Chemical Engineer, 4 years of professional experience.

More detailed information on these individuals is presented in Appendix A.

METHODOLOGY

The methodology utilized in the Whiteman AFB Records Search began with a review of past and present industrial operations conducted at the base. Information was obtained from available records such as shop files and real property files, as well as interviews with 37 past and present base employees from the various operating areas. A list of Air Force interviewees by position and years of service is presented in Appendix B.

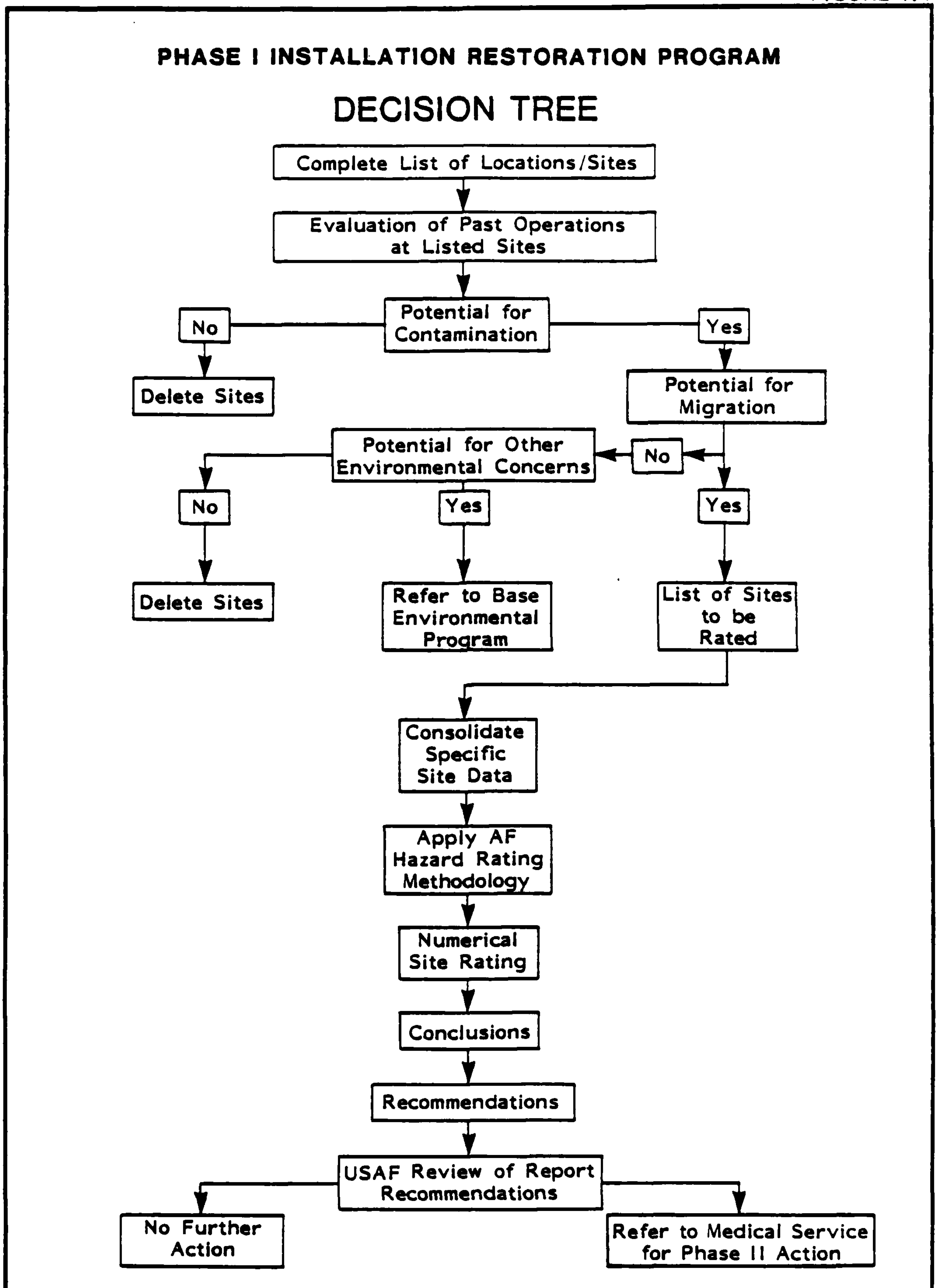
Concurrent with the base interviews, the applicable federal, state, and local agencies were contacted for pertinent base related environmental data. The agencies contacted and interviewed are listed below as well as in Appendix B.

- U.S. Environmental Protection Agency (EPA), Drinking Water Branch
- U.S. Geological Survey (USGS), Water Resources Division
- U.S. Army Corps of Engineers, Geotechnical Branch
- U.S. Department of Agriculture, Soil Conservation Service
- Missouri Division of Geology and Land Survey, Ground-Water Section
- Missouri Department of Natural Resources, Water Pollution Division
- Missouri Department of Natural Resources, Division of Environmental Quality
- Show-Me Regional Planning Commission
- Town of Knob Noster Water and Wastewater Department

The next step in the activity review was to identify all sources of hazardous waste generation and to determine the past management practices regarding the use, storage, treatment, and disposal of hazardous materials from the various Air Force operations on the base. A master list of industrial shops is provided in Appendix E. Included in this part of the activities review was the identification of all known past disposal sites and other possible sources of contamination such as spill areas.

A general ground tour and a helicopter overflight of the identified sites were then made by the ES Project Team to gather site-specific information including: (1) general observations of existing site conditions; (2) visual evidence of environmental stress; (3) the presence of nearby drainage ditches or surface water bodies; and (4) visual inspection of these water bodies for any obvious signs of contamination or leachate migration.

A decision was then made, based on all of the above information, whether a potential exists for hazardous material contamination at any of the identified sites using the Decision Tree shown in Figure 1.1. If no potential existed, the site was deleted from further consideration. For those sites where a potential for contamination was identified, a determination of the potential for migration of the contamination was made by considering site-specific conditions. If there were no further environmental concerns, the site was deleted. If there were other environmental concerns, these were referred to the base environmental program. If the potential for contaminant migration was considered significant, the site was evaluated and prioritized using the Hazard Assessment Rating Methodology (HARM). A discussion of the HARM system is presented in Appendix G.


PHASE I INSTALLATION RESTORATION PROGRAM
DECISION TREE
Complete List of Locations/Sites
Evaluation of Past Operations at Listed Sites
Potential for Contamination
No
Yes
Delete Sites
Potential for Migration
Potential for Other Environmental Concerns
No
No
Yes
Yes
Delete Sites
Refer to Base Environmental Program
List of Sites to be Rated
Consolidate Specific Site Data
Apply AF Hazard Rating Methodology
Numerical Site Rating
Conclusions
Recommendations
USAF Review of Report Recommendations
No Further Action
Refer to Medical Service for Phase II Action

SECTION 2

INSTALLATION DESCRIPTION

LOCATION, SIZE, AND BOUNDARIES

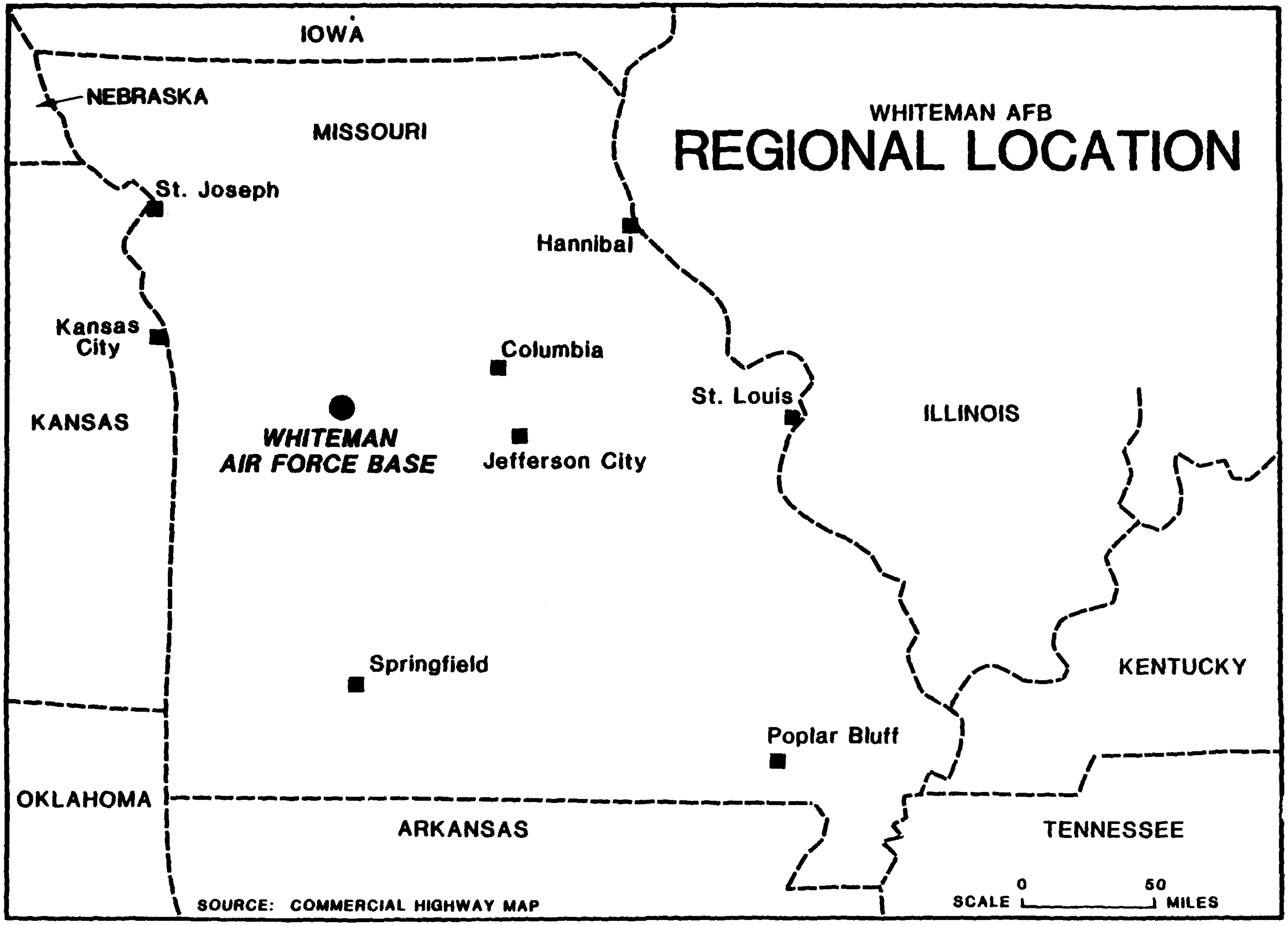
Whiteman Air Force Base is located in west-central Missouri, about nine miles east of Warrensburg, 22 miles west of Sedalia, and 65 miles southeast of Kansas City (see Figures 2.1 and 2.2). The base is bordered by agricultural land on the south and east, by Knob Noster State Park and low density residential areas on the west, and by the town of Knob Noster on the north.

The base comprises 4,676.47 acres of U.S. government-owned, leased, and easement land (see Figure 2.3). Remote installation facilities consist of the following:

- Warrensburg, Missouri Repeater Site (communications instrumentation), 8.54 acres of government- owned land.
- Sedalia, Missouri Repeater Site, 6.89 acres of leased land.
- Appleton City, Missouri Repeater Site, 6.89 acres of leased land.
- TVOR Site (navigation instrumentation), 0.23 acres of leased land.
- ILS Glide Slope (navigation instrumentation), 0.75 acres of government-owned land.
- 351st Strategic Missile Wing (SMW) sites, 20,115 acres.

The 351st SMW consists of 15 Minuteman II Intercontinental Ballistic Missile (ICBM) Launch Control Facilities (LCF's) and 150 Minuteman II ICBM Launch Facilities (LF's), located throughout west - central Missouri. One LCF is located on the main base property; the other LCF's and all LF's are remote installations. The total acreage associated with the 351st SMW remote sites, including U.S. government-owned land,

FIGURE 2.1



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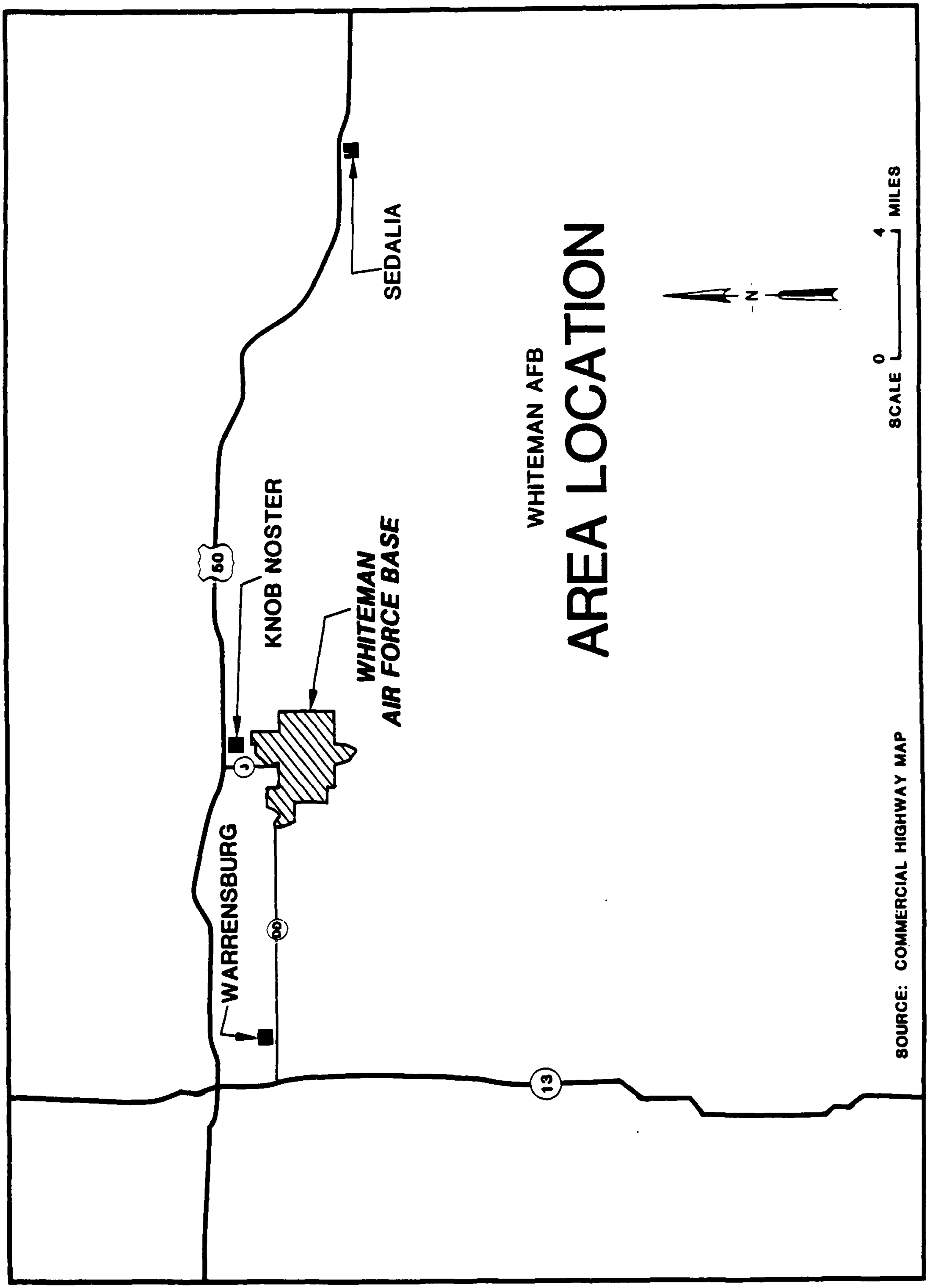
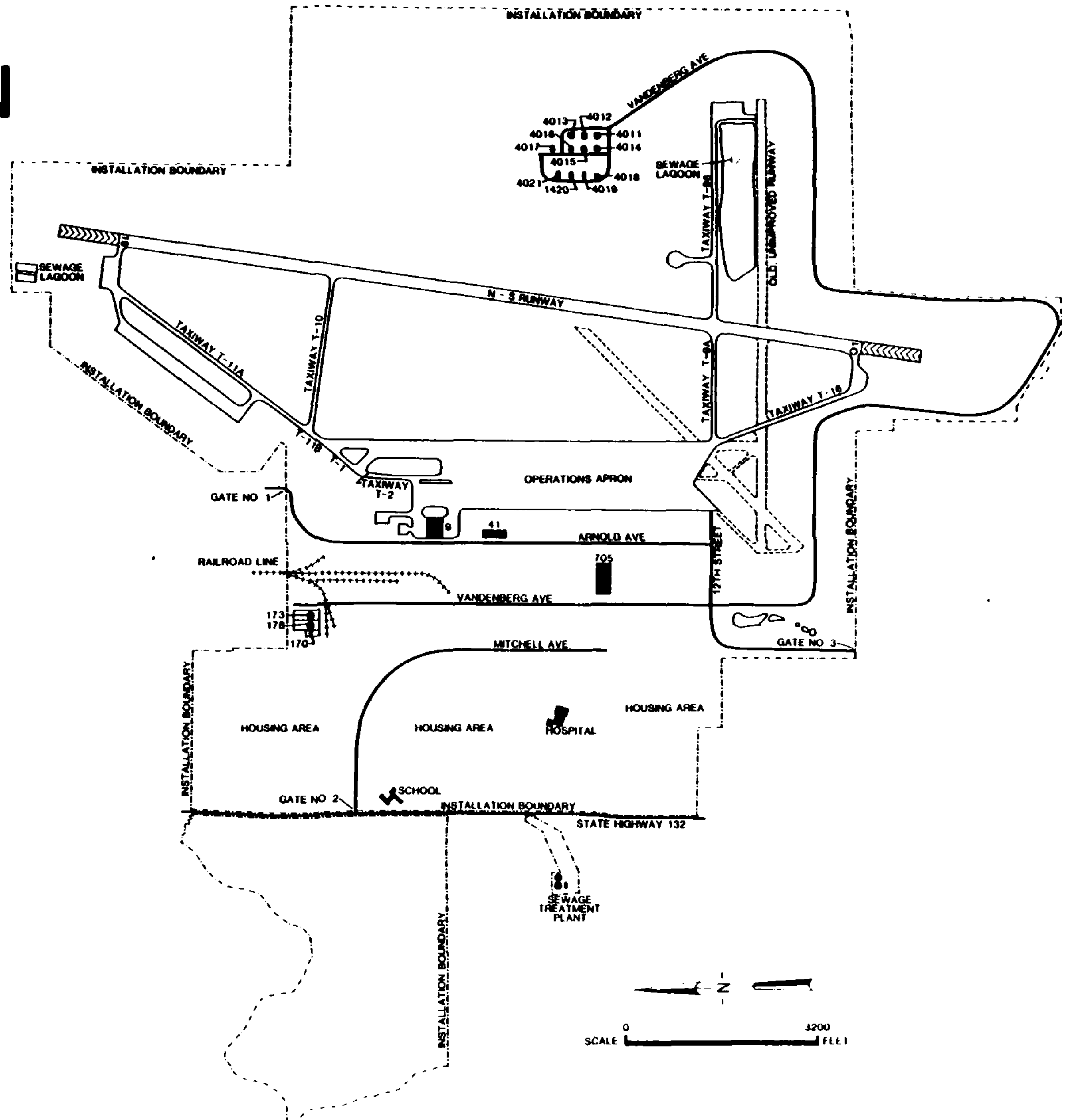

WHITEMAN AFB
AREA LOCATION
SEDALIA
KNOB NOSTER
WHITEMAN AIR FORCE BASE
WARRENSBURG
50
J
DD
13
N
SCALE 0 4 MILES
SOURCE: COMMERCIAL HIGHWAY MAP

WHITEMAN AFB INSTALLATION SITE PLAN



SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS

leased land, and easement land, is 20,115 acres. This acreage is spread over a land area of 15,625 square miles.

The missile LF's and LCF's are arranged in 15 flights (A-O) with an alphanumeric code as follows: A-01 indicates the LCF for flight A, A-02 through A-11 are the associated LFs. The same numerical designations hold for flights B through O. A diagram showing the approximate locations of the flights in relation to the base is presented in Figure 2.4.

BASE HISTORY

Whiteman Air Force Base was constructed and began operations in 1942. The base was originally activated as Sedalia Army Air Field and was assigned to the 12th Troop Carrier Command of the Army Air Force. The base served as a training site for glider tactics and paratroopers. Assigned aircraft included Douglas C-46s and C-47s, T-101s, and Waco CG-4A gliders. Sedalia Army Air Field served as a transition point for C-46 and C-47 crews after World War II until 1947, when it was placed in inactive status. Most of the original buildings on the base were disposed of after this inactivation.

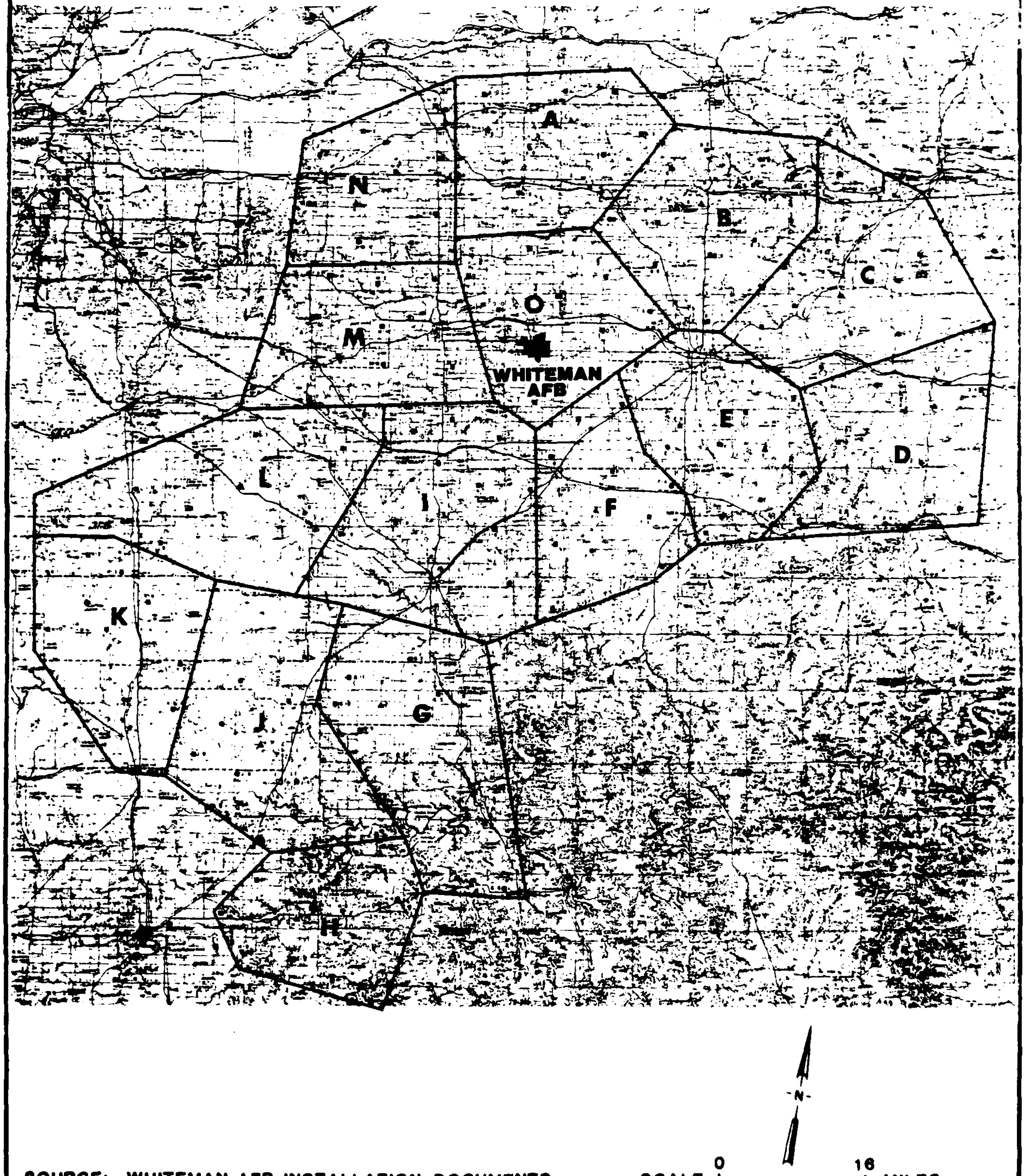
In August 1951 the base was reactivated as part of the Strategic Air Command (SAC). At this point, SAC also activated the 4224th Air Base Squadron to supervise the rehabilitation and construction of a new base, Sedalia Air Force Base (AFB). The 4224th continued its rehabilitation activities until October 20, 1952 when it was inactivated and the 340th Bombardment Wing, Medium, was activated at Sedalia AFB. The 340th was equipped with the Boeing B-47 Stratojet and with KC-97 tankers. Runway construction and other projects were completed in November 1953. The first assigned aircraft arrived in 1954 and in 1955, Sedalia AFB was renamed Whiteman AFB.

In June 1961, the Department of Defense announced that Whiteman had been chosen as the location of the fourth Minuteman ICBM wing. Construction of the sites was initiated in 1962 and completed in June 1964.

Prior to completion of construction, SAC activated the 351st Strategic Missile Wing (SMW) at Whiteman. The 340th Bombardment Wing gradually phased out operations during the early 1960's, transferring to Bergstrom AFB, Texas. The missile complexes became fully operational in June 1964.

WHITEMAN AFB

351st STRATEGIC MISSILE WING FLIGHT LOCATIONS



SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS

Since the mid-1960s, improvements and renovations have been made to the missile system and to the support facilities on Whiteman AFB. However, the major mission of the base remains the maintenance of national security through the Minuteman II ICBM wing assigned to the base, namely the 351st SMW.

ORGANIZATION AND MISSION

The host unit at Whiteman Air Force Base is the 351st Strategic Missile Wing. There are six major units in the 351st SMW. The Deputy Commander for Operations (DCO) controls the operations and management of the missile network; major subdivisions include the 508th, 509th, and 510th Strategic Missile Squadrons (SMS) and the 2154th Communications Squadron (CS). The Deputy Commander for Maintenance (DCM) is responsible for missile maintenance; subdivisions include the 351st Organization Missile Maintenance Squadron (OMMS) and the 351st Field Missile Maintenance Squadron (FMMS). The 351st Security Police Group (SPG) is responsible for security, both on the base and at the missile sites; organizations within the 351st SPG include the 351st and 352nd Missile Security Squadrons (MSS) and the 351st Security Police Squadron (SPS). The Deputy Commander for Resource Management (DCRM) controls the resources on the base, including supplies and transportation; major divisions are the 351st Transportation Squadron (TRNS) and the 351st Supply Squadron (SUPS). The 351st Combat Support Group (CSG) encompasses the service aspect and civil engineering operations on the base; the major units in the 351st CSG are the 351st Services Squadron (SVS) and the 351st Civil Engineering Squadron (CES). The sixth major unit, the USAF Hospital-Whiteman, provides health care to base personnel and other active and retired military personnel and their families in the area.

The tenant organizations at Whiteman Air Force Base are listed below. Descriptions of the major tenant organization and their missions are presented in Appendix C.

Air Force Commissary Service
Detachment 8, AF Institute of Technology
Detachment 9, Aerospace Rescue and Recovery Squadron (ARRS), MAC
Office of Special Investigation, Detachment 1206
Defense Property Disposal Office

Elementary School
Missouri National Guard
Detachment 31, SATAF
United Missouri Bank, Warrensburg, MO
U.S. Postal Service

SECTION 3

ENVIRONMENTAL SETTING

The environmental setting of Whiteman Air Force Base is described in this section with the primary emphasis directed toward identifying features that may facilitate the movement of hazardous waste-related contamination. Environmentally sensitive conditions pertinent to the study are highlighted at the end of this section.

CLIMATE

Temperature, precipitation, snowfall, and other relevant climatic data obtained from installation documents are presented in Table 3.1. The period of record is 24 years. The summarized data indicate that mean annual precipitation is 38.4 inches. Net precipitation is calculated to be minus 3.2 inches, based upon a Class A pan evaporation of 57 inches and an evaporation coefficient of 73 percent (from data published by NOAA, 1977). Net precipitation is an indicator of the potential for leachate generation and is equal to the difference between precipitation and evaporation. Rainfall intensity is an indicator of the potential for excessive runoff and erosion. The one-year, 24-hour rainfall for west-central Missouri in the vicinity of Whiteman AFB is approximately 6.7 inches.

GEOGRAPHY

The study area lies on the Osage Plains subdivision of the Central Lowlands Physiographic Province (Figure 3.1). The Osage Plains are described as old scarped plains beveled on slightly inclined subsurface strata (Lobeck, 1950). They are characterized by maturely dissected uplands, low rolling hills, and broad eroded valleys. Locally, the land surface appears to be flat or gently rolling, with little spatial variation. Major streams of the region are mature, intrenched, and underfit the valleys through which they flow.

TABLE 3.1
WHITEMAN AIR FORCE BASE CLIMATIC CONDITIONS

Month	Temperature (°F) Mean Max	Daily Min	Extreme Max	Extreme Min	Precipitation (In.) Monthly Mean	Max 24 hours	Snowfall (In.) Monthly Mean	Relative Humidity (In.) Monthly Mean
Jan	27	18	73	-19	1.6	2.0	8	74
Feb	33	24	82	-10	1.4	1.5	6	75
Mar	43	33	84	-6	3.0	2.3	5	78
Apr	56	45	92	19	4.1	4.7	1	75
May	65	55	94	31	4.5	2.9	#	80
Jun	73	64	98	45	4.6	3.4	0	81
Jul	78	68	105	47	3.9	6.7	0	81
Aug	77	66	106	48	3.1	5.1	0	83
Sep	69	58	100	38	3.5	4.8	0	83
Oct	58	47	94	23	3.5	3.8	#	78
Nov	44	35	82	4	2.2	3.3	2	76
Dec	34	25	72	-9	2.0	2.7	4	75
Annual	55	45	106	-19	38.4	6.7	26	78

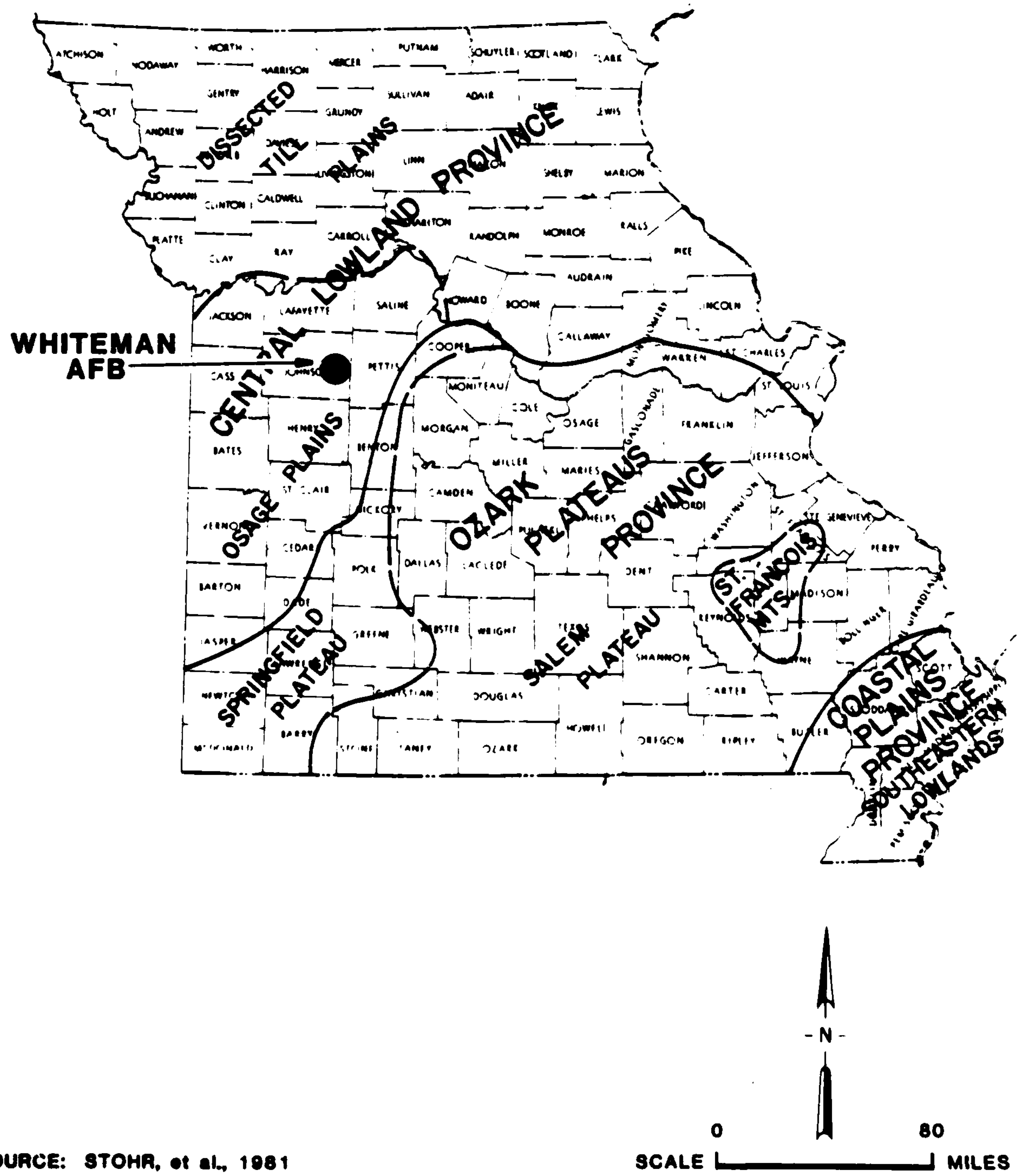
Source: Detachment 19, 26th Weather Squadron, Whiteman Air Force Base, MO

Note: # = Trace

FIGURE 3.1

WHITEMAN AFB

STUDY AREA PHYSIOGRAPHIC PROVINCES



SOURCE: STOHR, et al., 1981

Topography

Local relief is primarily the result of erosional activity of stream channel development and seldom exceeds fifty feet. Installation relief reaches a maximum of thirty feet along gullies present on the west margin of the base golf course. (Base Master Plan, 1982, Tab C-2). Installation elevations range from 715 feet, National Geodetic Vertical Datum (NGVD) (base golf course, west side) to 870 feet, NGVD, adjacent to the north end of the main instrument runway.

Drainage

Drainage of installation land areas is accomplished by overland flow to diversion structures, and then to area surface streams. Installation drainage is directed to Muddy Creek, Brewer Branch (of Clear Fork) and several other unnamed tributaries of Clear Fork. Clear Fork drains to the Blackwater River, northeast of the base. Installation drainage is shown on Figure 3.2. Study area drainage is generally considered to be slow to poor due to the presence of generally slow-draining soils at ground surface and typically subdued local relief (USDA, SCS, 1980). Flooding potential at Whiteman Air Force Base is uncertain, as installation files do not contain such information. Kane (1983) reports that the U.S. Army Corps of Engineers Kansas City District has no flood information currently on file relative to Whiteman AFB. A reconnaissance of base land areas suggests that intense rainfall may cause local flooding in low areas until such time as drainage structures and land features permit temporarily impounded runoff to dissipate.

Surface Soils

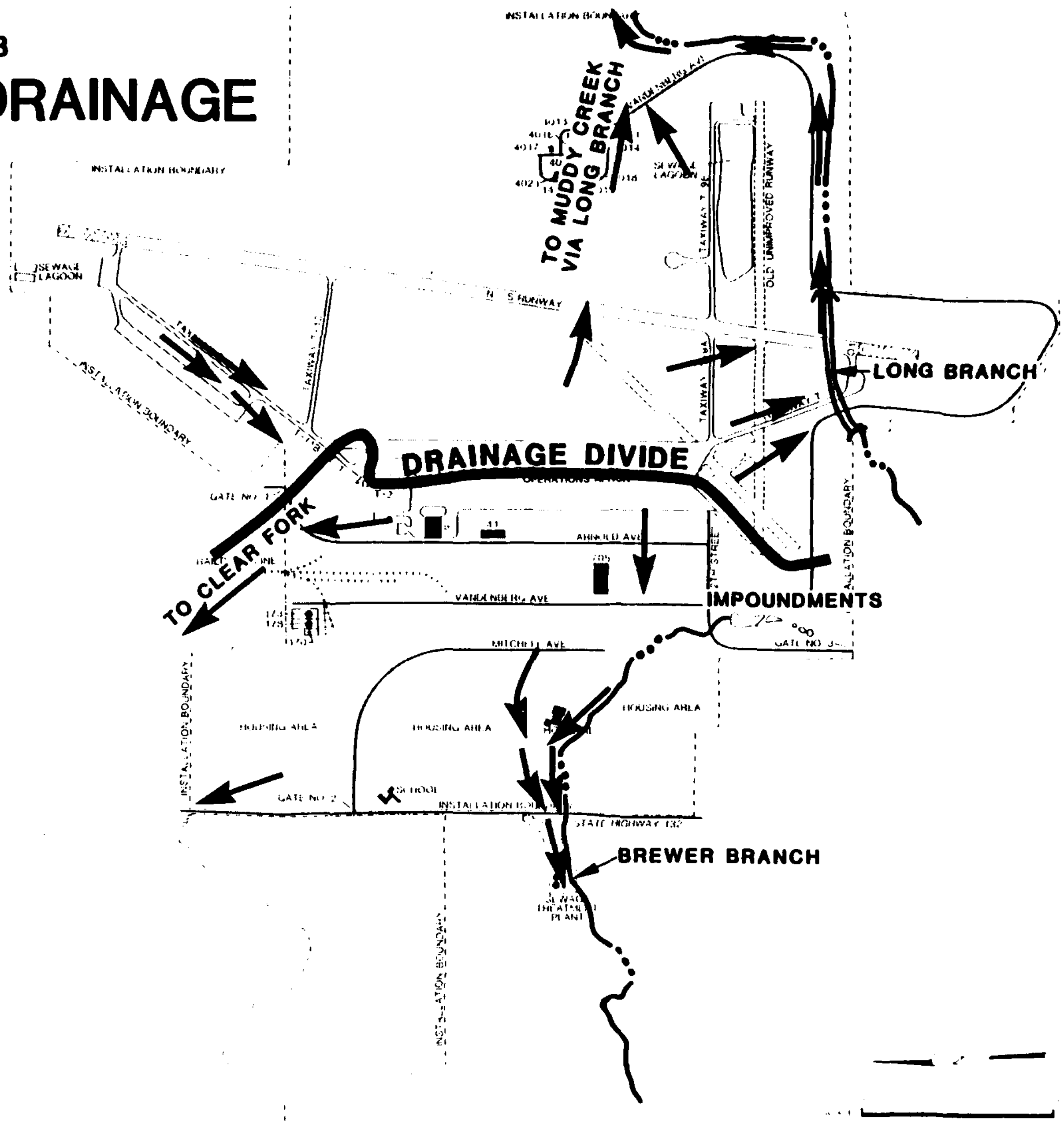
Surface soils of Johnson County have been described in a report published by the USDA, Soil Conservation Service (1980). Modern soils found within the study area have formed over loess (wind-blown silt) and residual materials (weathered rock) and are quite variable. Most installation soils are fine-grained and slow draining in the upper portion of their profile and tend to be sandier and freer-draining in lower portions of a typical profile. (A typical profile may be sixty to ninety inches thick, measured from ground surface). Table 3.2 describes

TABLE 3.2
WHITEMAN AIR FORCE BASE SOILS

Map Symbol	Unit Description	USDA Texture (Major Fraction)	Thickness (Inches)	Unified Classification (Major Fraction)	Drainage	Permeability (Inches/Hour)	Disposal Facility Use
DpB	Deepwater silt loam, 2-5% slopes	Silt loam	75	CL	-	0.6 - 2.0	Slight to moderate: wetness
DpC_2	Deepwater silt loam, 5-9% slopes	Silty clay loam	75	CL	-	0.6 - 2.0	Slight to moderate: wetness
Fs	Freeburg silt loam	Silt loam, clay loam, silty clay loam	82	CL,CL ML	-	0.2 - 2.0	Severe: wetness
GoC2	Gorin silt loam, 5-9% slopes	Silt loam, silty clay, silty clay loam	60	CL, ML, CH	Slow	0.6 - 2.0	Severe: wetness
Hg	Haig silt loam	Silt loam, silty clay loam, silty clay	64	CL, OL, CH	Slow	0.2 - 2.0	Severe: wetness
Hp	Haplaquents - urban land			Properties Not Estimated - Unknown			
HtA	Hartwell silt loam, 0-2% slopes	Silt loam, silty clay, clay, silty clay loam	78	CL, CL-ML, CH	Slow	0.06 - 0.6	Severe: wetness
HtB2	Hartwell silt loam, 2-5% slopes	Silt loam, silty clay, clay, silty clay loam	78	CL, CL-ML, CH	Slow	0.06 - 0.6	Severe: wetness
Lg	Lightning silt loam	Silt loam, silty clay loam, silty clay, clay	78	CL, CH, MH	Slow	0.06 - 0.6	Severe: wetness flooding
MdC	Mandeville silt loam, 5-9% slopes	Silt loam, shaly loam, silty clay loam, weathered bedrock	60	CL, CL-ML, ML	Slow	0.6 - 2.0	Moderate: shallow bedrock
Nd	Nodaway silt loam	Silt loam	60	CL, CL-ML	-	0.6 - 2.0	Severe: flooding
NoD	Norris shaly silt loam, 5-14% slopes	Shaly silt loam, weathered bedrock	60	ML, CL, SM, SC	-	0.6 - 2.0	Severe: shallow bedrock
NoF	Norris shaly silt loam, 14-35% shopes	Shaly silt loam, weathered bedrock	60	ML, CL, SM, SC	-	0.6 - 2.0	Severe: shallow bedrock
SaB	Sampsel loam, 2-5% slopes	Silty clay loam, silty clay, clay	88	CL, CH	Slow	0.06 - 0.6	Severe: wetness
SaC3	Sampsel loam, 5-9% slopes eroded	Silty clay loam, silty clay, clay	91	CL, CH	Slow	0.06 - 0.2	Severe: wetness
WdB	Weller silt loam	Silt loam, silty clay loam, silty clay	76	ML, CL, CH	-	0.06 - 2.0	Moderate: wetness
Zk	Zook loam	Silty clay loam, silty clay	90	MH, CH, CL, OL	Slow	0.06 - 0.6	Severe: wetness, flooding

Source: USDA, Soil Conservation Service (1980)
Symbol w is used to denote permanent surface water bodies.

WHITEMAN AFB
INSTALLATION DRAINAGE



LEGEND

→ DIRECTION OF FLOW

SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS

the principal characteristics of the seventeen soil units mapped on Whiteman Air Force Base. Figure 3.3 depicts the distribution of these soil units. Fourteen of the units impose moderate to severe limitations on the development of waste disposal facilities, primarily due to wetness, flooding, or shallow bedrock. All of the units may experience seasonally high water tables (i.e., within a few feet of ground surface) and have moderately slow to moderate permeabilities, primarily due to slow internal drainage of infiltrating precipitation. One unit which occupies some 1600 acres of the installation, "Haplaquents - Urban Land" was not described in Table 3.2, as its profile has been altered, buried, or completely removed locally as a result of extensive site use modifications and base construction activities.

GEOLOGY

Information describing the geologic setting of the Whiteman Air Force Base area has been obtained from Guild, et al. (1967); Show-Me Regional Planning Commission (1973); Anderson (1979); Stohr, et al. (1981); and Installation Documents, Tab C-6 (1982).

Stratigraphy and Distribution

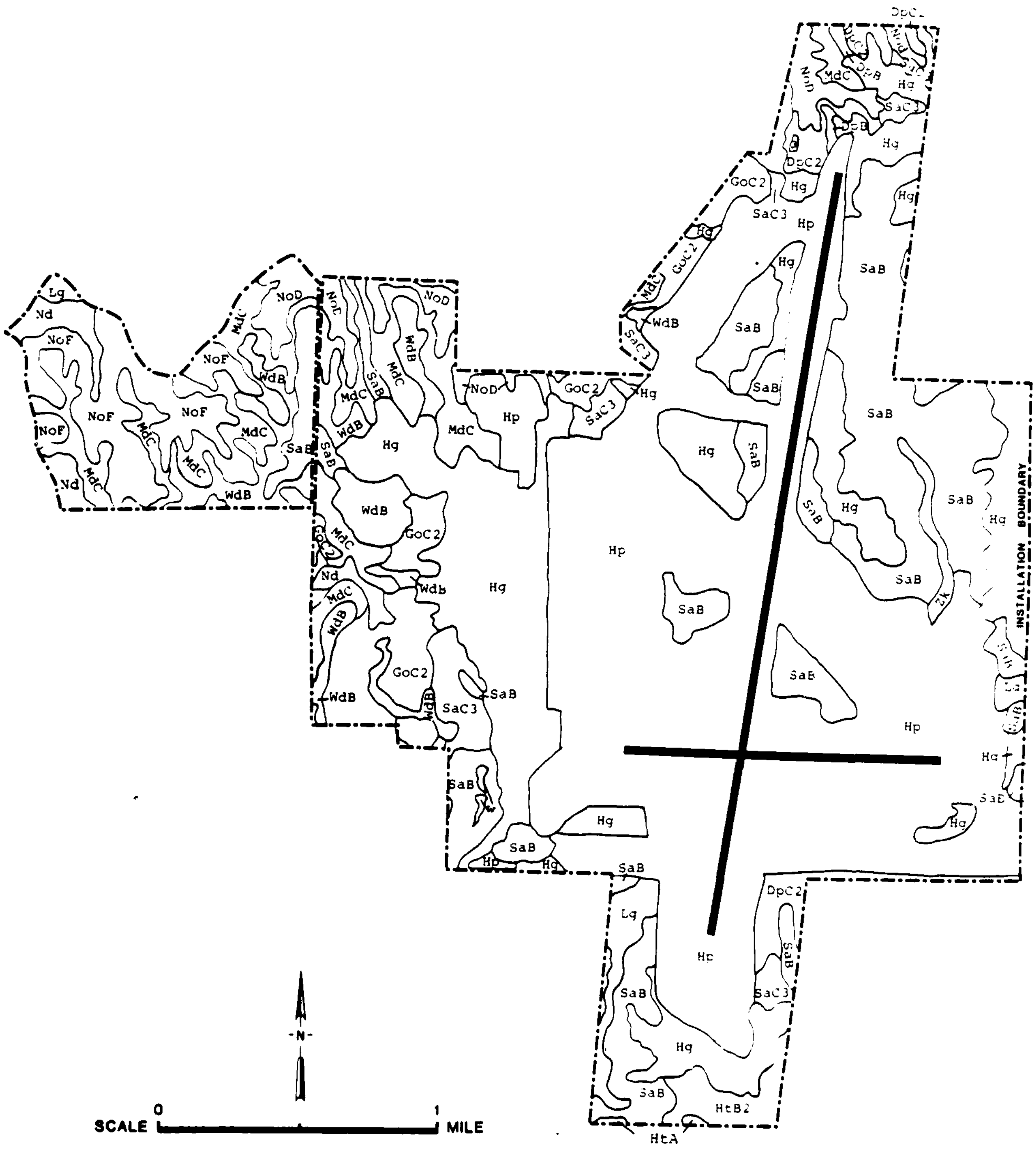
The geologic units of Johnson County include unconsolidated Quaternary deposits and Pennsylvanian sedimentary rocks. These units are listed in stratigraphic sequence and are briefly described in Table 3.3. The chief characteristics of each group or formation are briefly summarized.

Regional surficial geology is dominated by a thin (averaging twenty feet thick) mantle of loess and residual soil which has formed as a result of the weathering of the underlying bedrock. Locally, a soil layer may be completely absent, with bedrock exposed at ground surface. The loess is variable in thickness over the region and consists of silt, silty clay, or fine sandy silt. Locally, the loess may be absent. The residuum is reported to be thickest on gentle slopes. It is usually a clayey silt or sandy silty clay, occasionally containing sand or gravel.

Test borings advanced at Whiteman Air Force Base indicate that base surficial geology consists of a relatively thin mantle of silty, sandy, gravelly clay or a sand and clay mixture overlying bedrock. The unconsolidated surficial materials range in thickness from three feet (at

WHITEMAN AFB

SOILS



SOURCE: USDA SOIL CONSERVATION SERVICE, 1980

TABLE 3.3

GENERALIZED GEOLOGIC SECTION OF THE OSAGE PLAINS

System	Group or Formation	Thickness (Maximum)	Physical Characteristics	Hydrologic Characteristics	Engineering Geologic Characteristics of Surficial Materials and Bedrock
Quaternary	Alluvium	50 ft. 15 m	Unconsolidated, stratified deposits sand and gravel, silty clay, and silt loam.	Generally low yields but with isolated pockets of sand and gravel of higher yields. Water high in dissolved solids, particularly iron and bicarbonates.	Silt loam over silty clay; low to moderate plasticity and moderate permeability. Prone flooding.
	Loess	20 ft. 6 m	Silt loam.	Not an aquifer.	Clay-rich and relatively impermeable; low to moderate plasticity; highly erodible.
	Residuum	Variable	Silty, sandy, gravelly clay, clay-sand mixtures.	Seasonal perched water zones may be present locally. Soil-rock interface may contain water.	Moderate plasticity, low permeability.
Pennsylvanian	Kansas City Group	135 ft. 41 m	Alternating limestone and shale. Limestone formations form ledges.	Locally a minor water source; yields low. Water high in dissolved solids, particularly chlorides, iron, and biocarbonates. Higher quality water in the Warrensburg Sandstone Member.	Residual materials vary from thin cherty clay to silt loam. Limestone exhibits solution-enlarged joints; block slumping.
	Pleasanton Group	150 ft. 46 m	Shale, siltstone, and sandstone.		Very thin loess over reddish-brown silt loam to silty clay; blocky structue; moderate plasticity and permeability. Sandstones generally have high permeability; siltstones and shales have low permeability.
	Marmaton Group	190 ft. 58 m	Shale, sandstone, limestone, coal, and clay. Limestone forms ledges.	Not an aquifer.	Shale supported uplandsand slopes; very thin loess over gray-brown silty clay; high plasticity; low permeability low to moderate thickness. Clay has high shink/well potential.
	Cherokee Group	605 ft. 185 m	Sandstone, shale, limestone, siltstone, coal, and clay.		Very thin loess over gray-brown loam to silty clay; low moderate plasticity; moderate permeability due to silty or sandy soil. Soil is usually very thin.

Source: Modified from Stohr, et al., 1981.

installation boring number 5) to twenty-nine feet (at installation boring number 8) and tend to be fine-grained and plastic. Bedrock was encountered immediately beneath the silty, sandy, gravelly clay stratum at elevations ranging from 833 to 804 feet, MSL. The variable nature of base subsurface conditions is depicted on Figures 3.4 and 3.5, the logs of two installation test borings. The locations of the two representative borings are shown on Figure 3.6. The bedrock encountered below the regolith was described on the boring logs as being a shale of limestone. This description probably corresponds to the upper Cherokee Group (Cabaniss Subgroup), a cyclic occurrence of Pennsylvanian - age limestone, shale, sandstone, siltstone, underlay, and coal. The study area's bedrock geology is dominated by the Cherokee which forms a relatively thick (150 feet thick at base Well No. 2), flat-lying sequence of sedimentary rocks. The Cherokee is in turn underlain by considerable thicknesses of Mississippian, Ordovician and Cambrian Sedimentary rocks. Figure 3.7, the log of Base Well No. 3, depicts the major geologic units in stratigraphic succession, as they were encountered during the well-drilling process. Regionally consolidated geologic units are known to have undergone folding and minor faulting, which has created petroleum - retaining structures such as traps, folds, and domes. It is thought that major faulting at great depth is ultimately responsible for the generation of less intense deformation apparent in the near-surface (Stohr, et al, 1981).

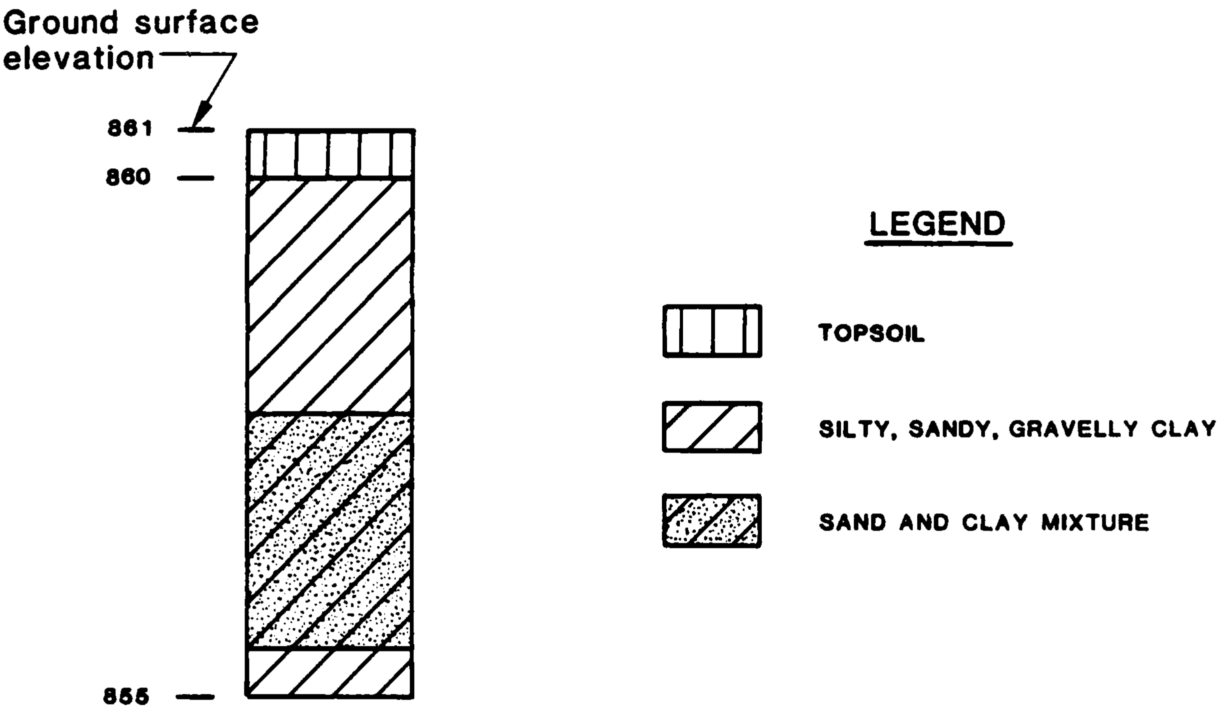
GROUND-WATER HYDROLOGY

Information describing the hydrology of the project area has been obtained from Gann, et al. (1974); Taylor (1978); and Schroeder (1982). Additional data have been obtained from a telephone communication with a Missouri Geologic Survey (Ground-Water Section) Scientist.

Whiteman Air Force Base lies in an area of western Missouri where several major hydrologeologic units have been identified. The units of particular interest to this investigation include the following:

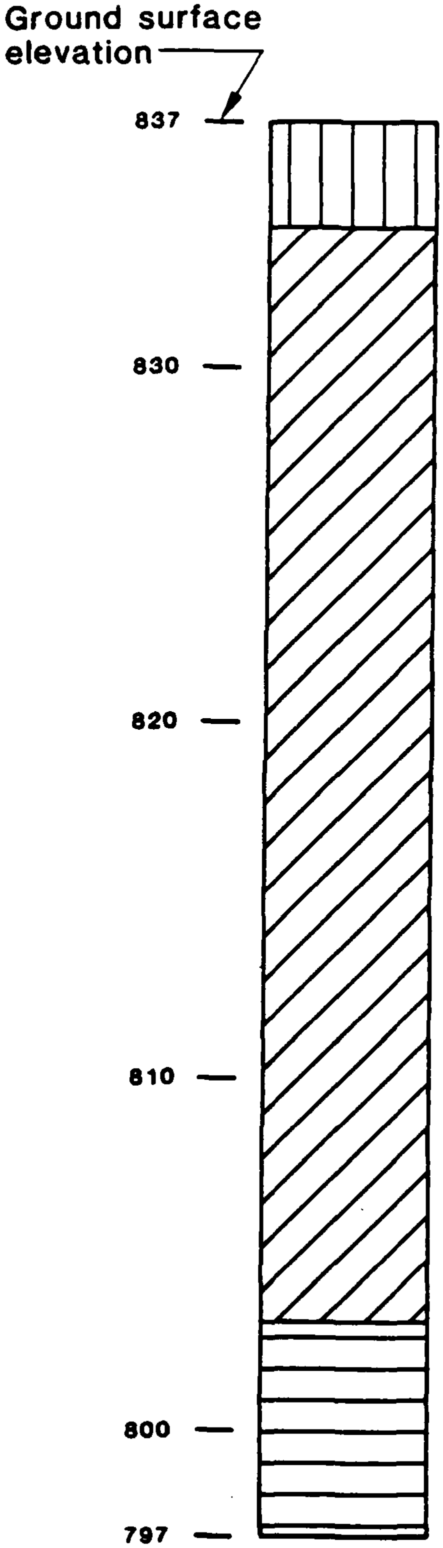
WHITEMAN AFB

LOG OF INSTALLATION SOIL BORING NO. 6



NOTE: LOCATION SHOWN ON FIGURE 3.6.
GROUND-WATER LEVEL NOT RECORDED.

SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS



WHITEMAN AFB

LOG OF INSTALLATION SOIL BORING NO. 8

LEGEND

TOPSOIL

SILTY, SANDY, GRAVELLY CLAY

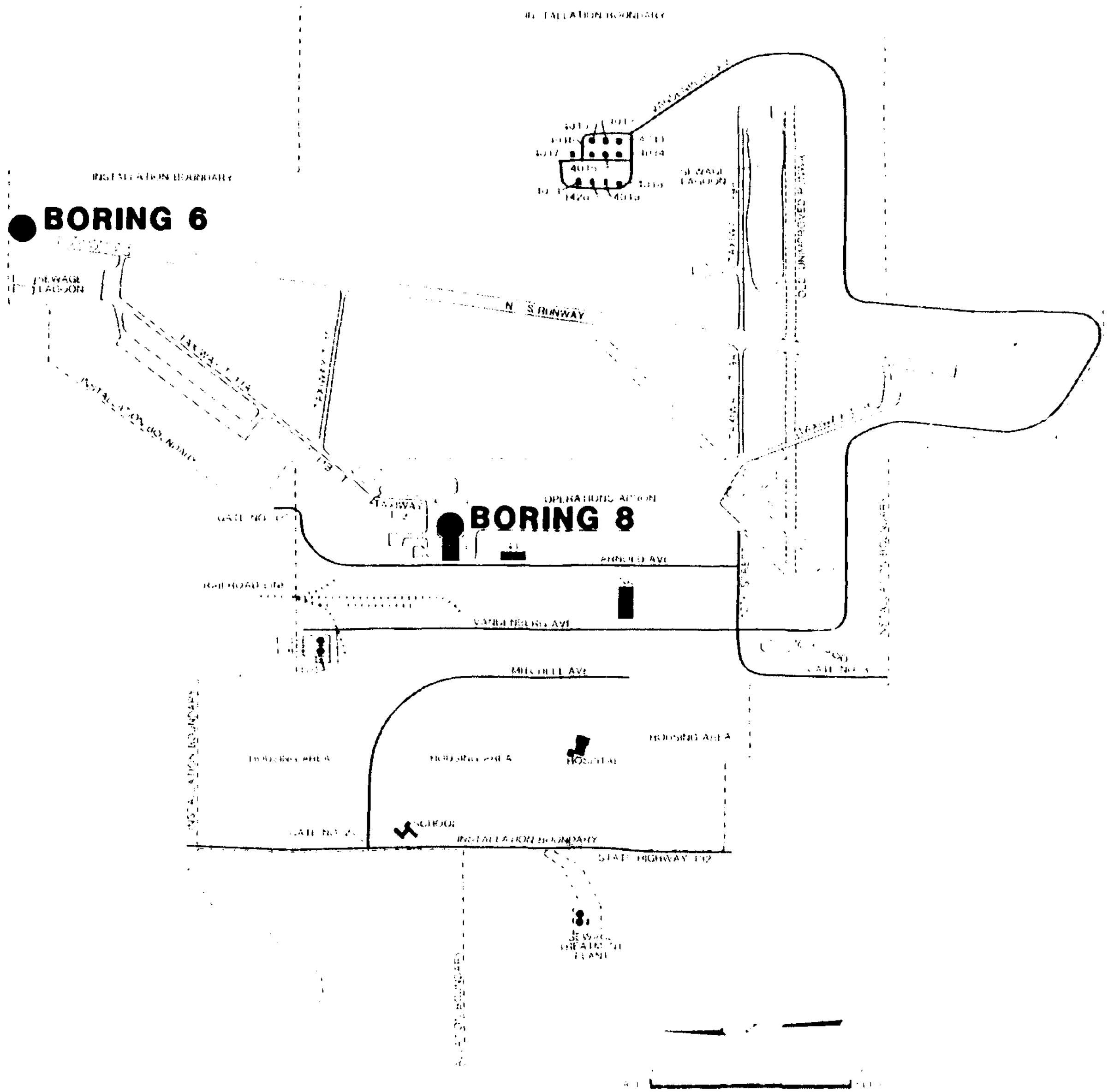
SHALE OR LIMESTONE

NOTE: LOCATION SHOWN ON FIGURE 3.6.
GROUND-WATER LEVEL NOT RECORDED.

SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS

WHITEMAN AFB

LOCATIONS OF REPRESENTATIVE INSTALLATION TEST BORINGS

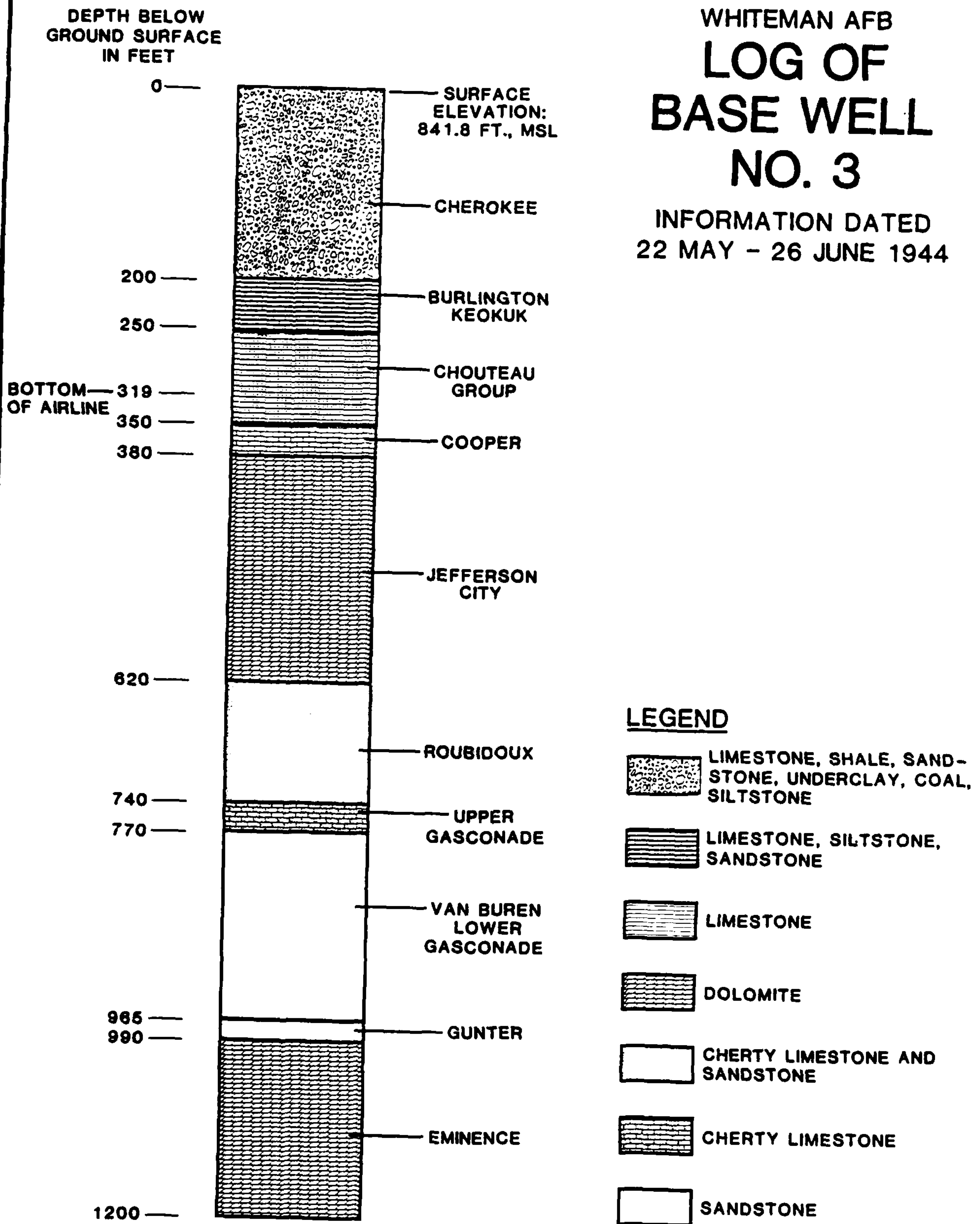


SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS

FIGURE 3.6

WHITEMAN AFB LOG OF BASE WELL NO. 3

INFORMATION DATED 22 MAY - 26 JUNE 1944



MISSOURI BUREAU OF MINES SURVEY NUMBER 7830

NOTE: LOCATION OF WELL SHOWN ON FIGURE 3.9

SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS

- o Surficial deposits
  - Alluvium
  - Loess
  - Residuum
- o Bedrock units
  - Pennsylvanian
  - Mississippian
  - Ordovician
  - Cambrian

Table 3.4, modified from the Show-Me Regional Planning Commission (1973) and Gann, et al., (1974), summarizes the probable hydrogeologic characteristics of these units. The values listed are estimates based upon data from a few wells drilled in the general study area. Locally, conditions could be highly variable. Figure 3.8, a hydrogeologic cross-section, depicts the relationships of the major units within the study area. Figure 3.8A is a key map for the hydrogeologic cross-section.

At Whiteman Air Force Base, surficial deposits occur at land surface and average twenty feet in thickness. Alluvial materials (deposited by stream flow) are typically restricted to zones immediately adjacent to streams. Loess and residual materials probably comprise the largest portion of the surficial deposits present at the base. Their true water-bearing characteristics are uncertain. They probably contain ground water at least seasonally, but may run dry during summer months. Ground water, if present, likely occurs in the alluvium near flowing streams, as perched water in isolated sandy zones within the residuum, or as perched water at the residuum/bedrock interface. In this case, perched water means ground water whose flowpath to lower permanently saturated zones has been impeded by clay layers, hardpan, continuous bedrock, etc. Eventually, the perched water will infiltrate laterally or vertically into other areas, provided that no additional recharge occurs. It is assumed that precipitation is the primary means by which surficial deposits are recharged. The base is located in a recharge zone for the shallow system. Most discharge is probably directed to local surface streams. Minor amounts of discharge could be directed to

TABLE 3.4
STUDY AREA HYDROGEOLOGIC UNITS

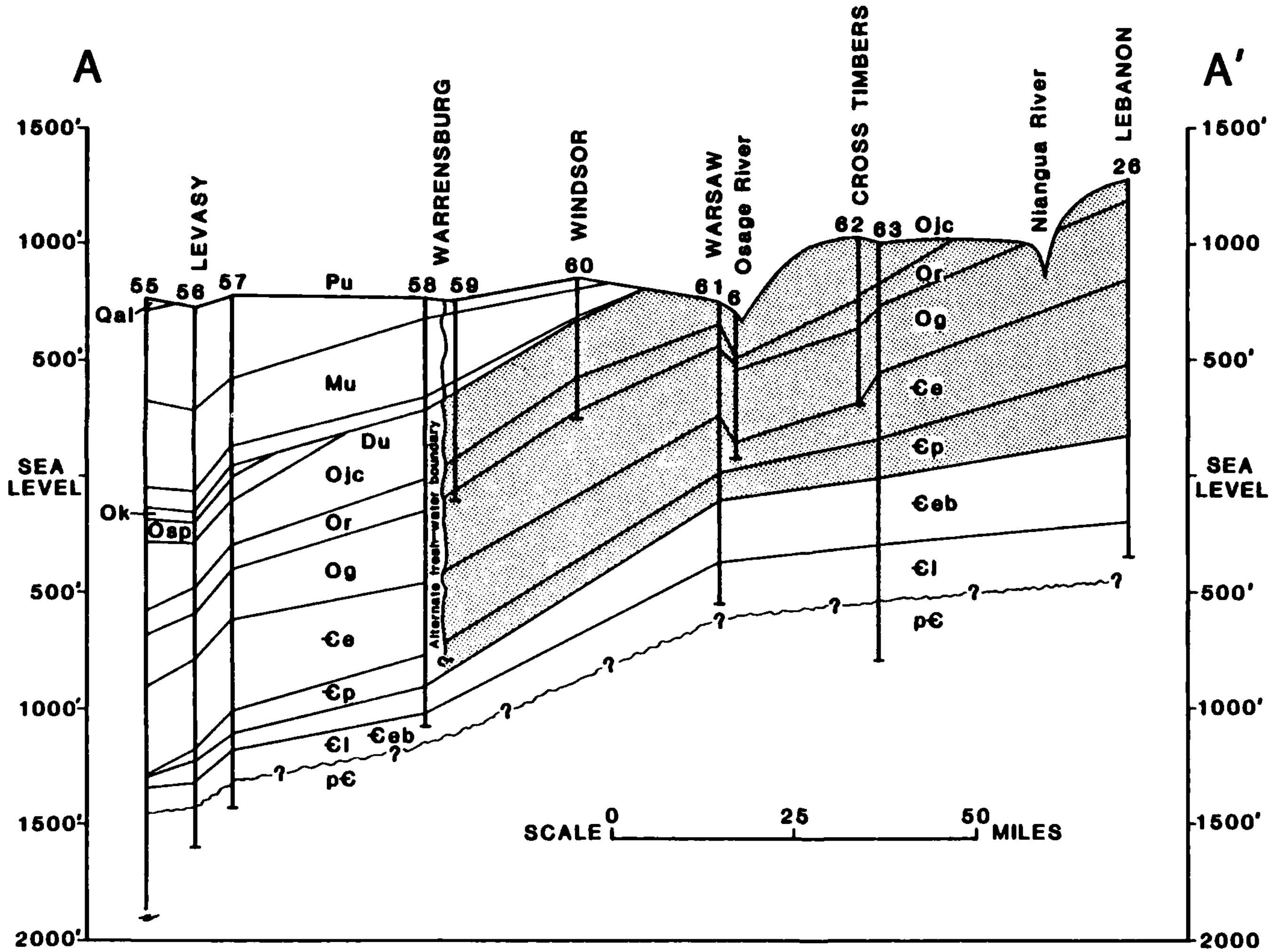
System	Series	Hydrogeologic Unit	Estimated Thickness at WAFB (ft.)	Lithology	Remarks
Quaternary	Holocene Pleistocene	Alluvium, residuum Loess	0 - 30	Clay, silt, sand, gravel	Poor water - bearing properties. Not normally used for water supplies.
Pennsylvanian	Des Moines	Cherokee Group	150-200	Shale, limestone, clay coal, siltstone	Poor aquifer. Yield range: 1-3 gpm.
Mississippian	Osage	Keokuk Burlington	50	Limestone, dolomite, cherty limestone	Poor aquifer. Yield range: 1-15 gpm. Adequate for domestic use.
	Kinderhook	Chouteau Group	100	Limestone, siltstone, sandstone	Not important as an aquifer.
Ordovician	Middle & Lower	Jefferson City Roubidoux Gasconade (Gunter member)	600	Dolomite Dolomite Dolomite Sandstone	Good aquifer. Yield range: 15-125 gpm.
Cambrian	Upper	Eminence	>200	Dolomite	Excellent aquifer. Yield range: 250 + gpm.

Sources: Show-Me Regional Planning Commission, 1973
Gann, et al, 1974
Stohr, et al., 1981

FIGURE 3.8

WHITEMAN AFB

HYDROGEOLOGIC CROSS-SECTION



VERTICAL SCALE GREATLY EXAGGERATED

EXPLANATION

Qal, Alluvium
Pu, Pennsylvanian, undivided
Mu, Mississippian, undivided
Du, Devonian, undivided
Ok, Kimmswick Limestone
Osp, St. Peter Sandstone
Ojc, Powell, Cotter, and Jefferson City Dolomites
Or, Roubidoux Formation
Og, Gasconade Dolomite (including Gunter Sandstone Member)
Єe, Eminence Dolomite
Єp, Potosi Dolomite
Єeb, Elvins Group (Doe Run Dolomite, Derby Dolomite, and Davis Formation) and Bonneterre Dolomite
Єl, Lanotte Sandstone
pЄ, Precambrian rocks

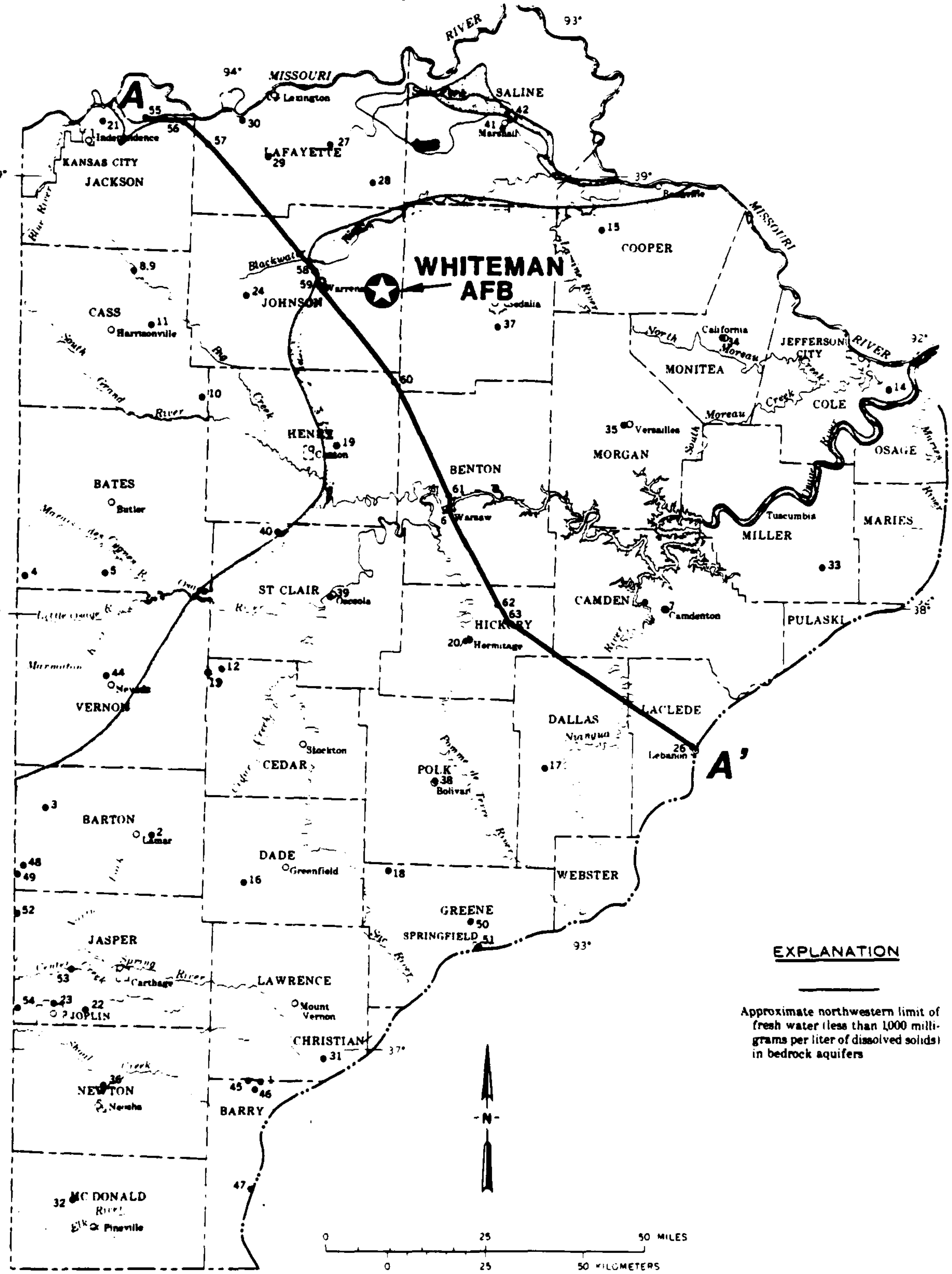
MOST FAVORABLE AQUIFERS ARE SHADED.

NOTE: CROSS-SECTION LOCATION IS SHOWN ON FIGURE 3.8A.

SOURCE: GANN, ET AL., 1974

FIGURE 3.8 A

WHITEMAN AFB
HYDROGEOLOGIC CROSS-SECTION LOCATION



SOURCE: GANN, ET AL., 1974

deeper aquifers. Because of the many limiting factors, surficial deposits are not utilized by local consumers as a source of water supplies.

The Pennsylvanian-age Cherokee Group forms the uppermost bedrock unit present at Whiteman Air Force Base. The Cherokee is some 150-200 feet thick at the installation and consists of fairly tight shale, siltstone, sandstone, coal, underclay, and limestone. Ground water is present in fractures, seams, and along bedding planes under generally water table (unconfined) conditions. The principal source of recharge is thought to be infiltrating precipitation. Discharge (in the uppermost Cherokee) may be directed to surface streams. Discharge from lower sections of the Cherokee is probably directed to lower bedrock units. In the study area, the Cherokee is seldom employed as a source of water due to low, uncertain yields and locally mineralized water (Gann, et al., 1974). The Cherokee is considered to be a valuable source of mineral resources such as coal and petroleum products, rather than drinking water in Johnson County.

The Mississippian-age Salem, Keokuk, and Burlington Limestones are encountered at greater depth below the Cherokee Group. The Mississippian rocks form a sequence some 150 feet thick at Whiteman Air force Base. Ground water may be present in solution channels, seams, fractures, or along bedding planes. Yields tend to be low and water quality variable (Stohr, et al., 1981). Mississippian system units are probably recharged to some degree by precipitation where the units occur at or near land surface, in Pettis County, east of the base. Additional recharge may be derived from hydraulically communicating aquifers. The Mississippian units are seldom utilized as a source of ground-water supplies as better quality, more reliable supplies are typically obtained from deeper units.

Ordovician-age aquifers include the Jefferson City Dolomite, the Roubidoux Formation, and the Gasconade Dolomite (including the Gunter Sandstone). These units provide moderate to good supplies of water in the study area. Locally, the units may provide only mineralized water supplies. The recharge of the Ordovician units is probably similar to that of the overlying Mississippian rocks.

The Cambrian system, represented in the study area by the Eminence Dolomite, is the deepest hydrogeologic unit. Ground water occurs in the

Eminence under typically artesian (confined) conditions in pores, solution channels, fractures, or along bedding planes. It is a reliable, highly prolific source of good quality water supplies of regional importance. Most municipal systems in the study area, including Whiteman Air Force Base, derive their water supplies from it. It is likely recharged by regional flow from hydraulically communicating units or by limited precipitation infiltration in areas east of the base in Pettis County. Ground water contained within the Eminence rises under aretesian pressure to a point 150-200 feet below ground surface.

Water Quality

Municipal water distribution systems in Johnson County normally derive water resources from deep rock aquifers. Water obtained from these units (Ordovician and Cambrian) is usually hard and possesses varying concentrations of inorganic substances. Domestic and small-quantity consumers occasionally make use of shallow rock aquifers such as the Pennyslvanian Cherokee Group, which occurs near ground surface at the base. Water quality data suggests that supplies obtained from the Cherokee may contain elevated concentrations of naturally-occurring sodium, bicarbonate, sulfate, chloride, and dissolved solids. Table 3.5 summarizes ground-water quality data for a few Whiteman AFB and satellite facilities wells. The summarized historical water quality data and 1983 data on file at BES indicate that ground-water-derived supplies for Whiteman AFB and associated facilities are generally of good quality. Occasionally iron may be present in elevated concentrations in base well water.

Base Wells

Whiteman Air Force Base derives its water resources from a supply system based on seven wells. At this time, one well is down for repairs. These wells are open into the Ordovician and Cambrian aquifers. Base static water levels (i.e., depth to the artesian water surface below grade) varied from 165 to 190 feet during calendar year 1983. Table 3.6 summarizes base well information. Base well locations are shown on Figure 3.9.

Area Wells

The City of Knob Noster obtains its water supplies from a municipal system utilizing three deep wells. The wells average 900 feet in depth,

TABLE 3.5

GROUND-WATER QUALITY FOR SELECTED WHITEMAN AFB WELLS

Well Number	Well Location: County	Section	Township (N)	Range (W)	Well Characteristics: Sampling depth or total depth (feet)	Depth of casing (feet)	System	Rate of pumping (gpm)	Specific capacity (gpm/ft of draw-down)	Water Quality: Date of collection	Milligrams per liter: Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Calcium, Magnesium	Noncarbonate	pH
WAFB No. H-1	Cedar	30	36	28	300	212	M	10	.1	8-18-67	7.7	.06	.02	36	19	41	4.1	229	24	29	.9	.4	269	168	0	7.8
										9-12-83	-	1.1	ND	34	-	-	-	-	23	20	1.1	ND	272	-	-	-
WAFB No. M-1	Johnson	6	45	27	423	275	P	8	.1	8-18-67	8.0	2.4	.07	28	15	723	15	779	264	580	1.8	.5	2060	132	0	8.0
WAFB No. 2	Johnson	33	46	24	1025	503	0	300	2.4	8-18-67	4.4	2.3	.09	34	21	36	3.9	237	14	29	.6	0	227	172	0	7.9
WAFB No. G-1	St.Clair	2	39	27	292	199	M	10	.4	8-18-67	8.0	.24	.72	99	85	168	18	448	573	21	.4	1.9	1250	597	230	7.7
WAFB No. A-1	Saline	4	29	23	584	256	0	13	.05	8-17-67	1-	.09	.02	185	70	142	12	477	593	44	.6	.2	1390	750	359	7.7

Source: Gann, et al., 1974 and Whiteman AFB Installation Documents, 1984.

Results reported in milligrams per liter. ND = not detected.

Note: System indicated as follows: P = Pennsylvanian
M = Mississippian
O = Ordovician

TABLE 3.6

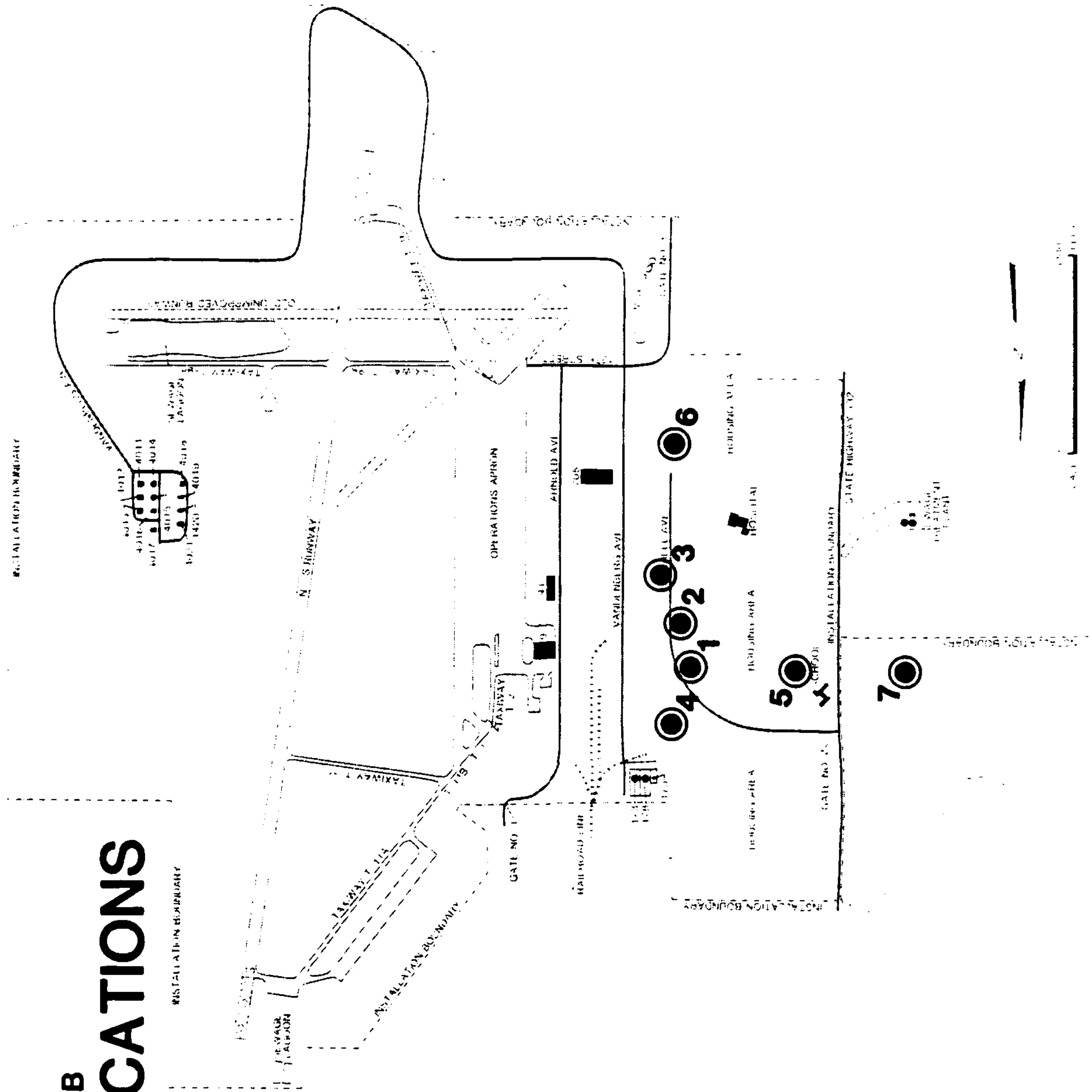
WHITEMAN AIR FORCE BASE WELL INFORMATION

Well No.	Depth (Feet)	Diameter (Inches)	Aquifers(s)	Static Water Level (Feet below LSD)[1]	Pumping Water Level (Feet below LSD)[1]	Date of Measurement	Drawdown (Feet)	Pump Depth (Feet below LSD)[1]	Average Capacity (1983)	Remarks
1	1025	10	Ordovician/Cambrian	185	320	11/15/80	135	400	225	-
2	1037	10	Ordovician/Cambrian	190	344	11/15/83	154	441	150	-
3	1171	10	Ordovician/Cambrian	175	290	12/1/83	115	350	275	-
4	1050	10	Ordovician/Cambrian	165	313	10/4/83	148	410	240	-
5	1075	10	Ordovician/Cambrian	179	243	5/31/79	64	350	300	-
6	1040	10 *	Ordovician/Cambrian	192	377	8/7/80	185	480	230	Not in service.
7	1004	10	Ordovician/Cambrian	154	228	11/3/76	74	380	180	Serves golf course on "as needed" basis.

Source: Installation Documents

[1]LSD: Land Surface Datum

WHITEMAN AFB
BASE WELL LOCATIONS



LEGEND

WELL NO.	BUILDING NO.
1	1800
2	1900
3	2090
4	167
5	1113
6	890
7	3074

SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS

and therefore, appear to draw water from the Ordovician system (Jefferson City, Roubidoux, and Gasconade). Two trailer parks located west of the base also utilize their own wells for water supply purposes. The aquifer from which they draw water is not known. Presumably, trailer park wells would be sealed into the Ordovician system, which could provide water in the quantities required by a multiple-user system.

Domestic and agricultural consumers located near the base typically use their own wells. It is not known which aquifers these consumers are using to obtain water supplies. Figure 3.10 depicts the locations of study area water wells, based upon a physical inspection of the lands adjacent to Whiteman AFB and personal contact with Knob Noster Water and Wastewater Department personnel (Smith, 1983).

Satellite Facilities Wells

Water supplies for satellite facilities are obtained from individual wells installed at each launch control facility. The wells are typically of moderate depth (300 - 400 feet) and modest capacity (50 gpm). Table 3.7 summarizes satellite facilities well data.

SURFACE WATER QUALITY

Base drainage is roughly divided between Long Branch and its tributaries on the east and Brewer Branch and its respective tributaries to the west. Also, some seventy percent of the wastewater produced by Whiteman AFB is discharged to Brewer Branch. USGS topographic maps (1955 and 1981) of the study area depict Brewer Branch as a perennial stream from the installation boundary adjacent to State Route 132 to its confluence with Clear Fork. The 0.8 mile long reach of Brewer Branch flowing on base is depicted as an intermittent stream, from a point 1,000 feet east of Route 132 to the point where the stream rises, in the southwest corner of the base. Long Branch is depicted as a perennial stream where it traverses base property. The upstream watersheds of these two principal study area streams are relatively small and consist of agricultural land. A small quantity of installation drainage is directed northwest from the base along unnamed, intermittently flowing tributaries to the area's major stream, Clear Fork. The upstream watershed for these intermittent tributaries is base land (flightline and

FIGURE 3.10

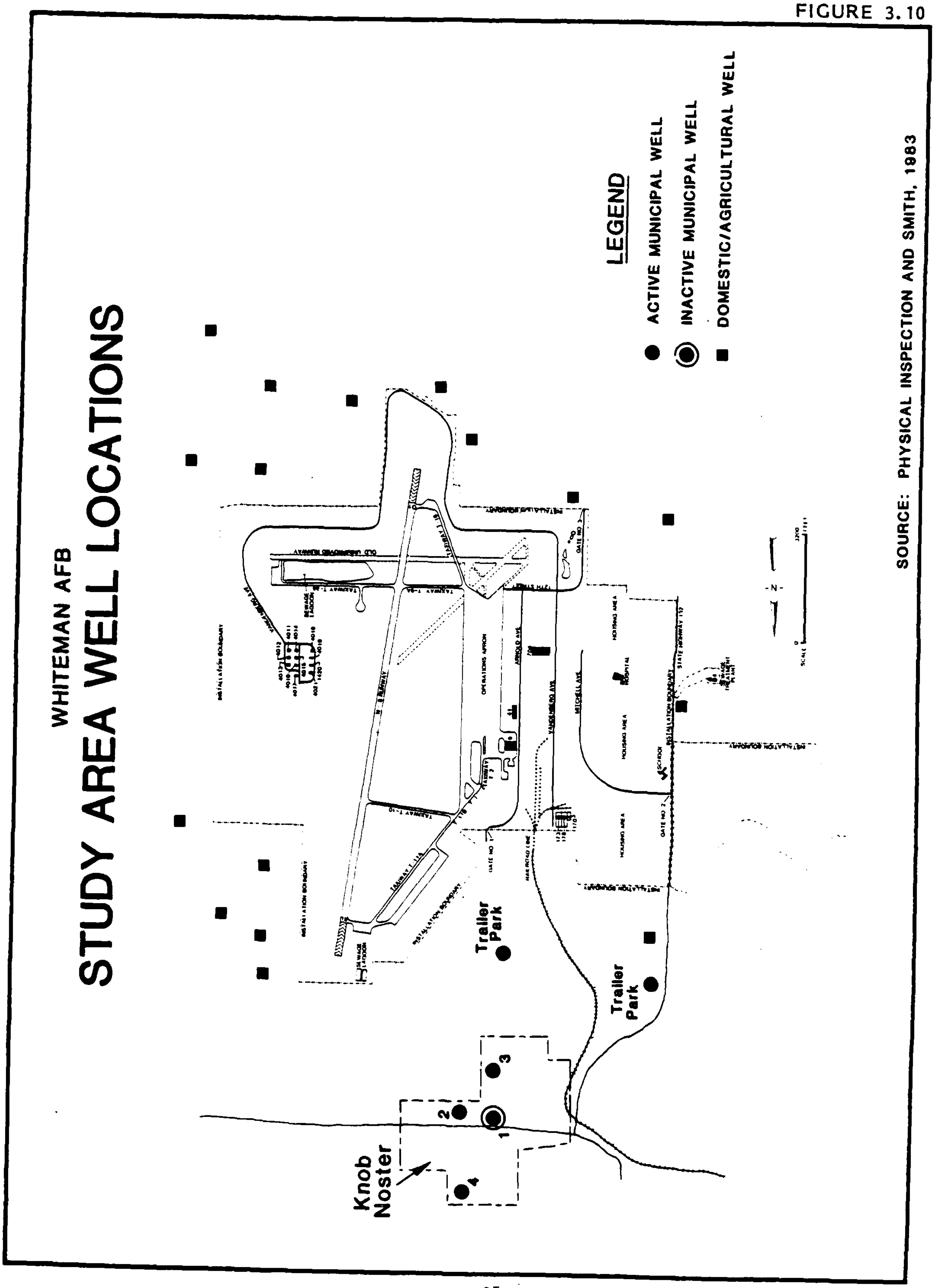

WHITEMAN AFB
STUDY AREA WELL LOCATIONS
LEGEND
ACTIVE MUNICIPAL WELL
INACTIVE MUNICIPAL WELL
DOMESTIC/AGRICULTURAL WELL
SOURCE: PHYSICAL INSPECTION AND SMITH, 1983
Knob Noster
1
2
3
4
Trailer Park
Trailer Park

TABLE 3.7
MISSILE FACILITIES WELL DATA

Site	Well Status	Total Depth (Feet)	Casing Length (Feet)	Aquifer*
A-1	Not in use	280	256	Mississippian
A-1	Not in use	384	192	Ordovician
B-1	In service	438	265	Pennsylvanian
C-1	In service	408	260	Pennsylvanian
D-1	In service	308	225	Pennsylvanian
E-1	In service	320	200	Pennsylvanian
F-1	In service	331	265	Mississippian
G-1	Not in use	175	155	Pennsylvanian
G-1	In service	292	199	Mississippian
H-1	In service	300	212	Mississippian
I-1	In service	443	228	Mississippian
J-1	In service	400	241	Mississippian
K-1	In service	100	96	Pennsylvanian
K-1	Not in use	800	520	Ordovician
L-1	Not in use	121	97	Pennsylvanian
L-1	Not in use	393	379	Mississippian
M-1	Not in use	322	275	Mississippian
M-1	Plugged	423	275	Pennsylvanian
N-1	Not in use	420	384	Pennsylvanian
N-1	Not in use	563	460	Mississippian
O-1	Base dist. system	--	--	--

*Estimate, based on well depth

Source: Whiteman AFB Documents

fuel storage drainage). Streams proximate to the base are not classified according to their use and are utilized as a source of potable water supplies.

The water quality of the aforementioned streams is monitored quarterly at six strategic locations by BES personnel. The water quality sampling locations are depicted on Figure 3.11. Appendix D Tables D-2 and D-3 summarize representative monitoring data and standards. Other data are available from base records for review.

A review of the appended historical water quality data suggests that, in general, all sampling points indicate the presence of ammonia nitrogen, most metals, solvents, and pesticides in local surface waters exceeding permit values. The metals and solvents concentrations may be due in part to base functions; however, ammonia nitrogen and pesticide levels may be associated in part or whole with local agricultural activity. Specific data are presented in Table D.2.

THREATENED OR ENDANGERED SPECIES

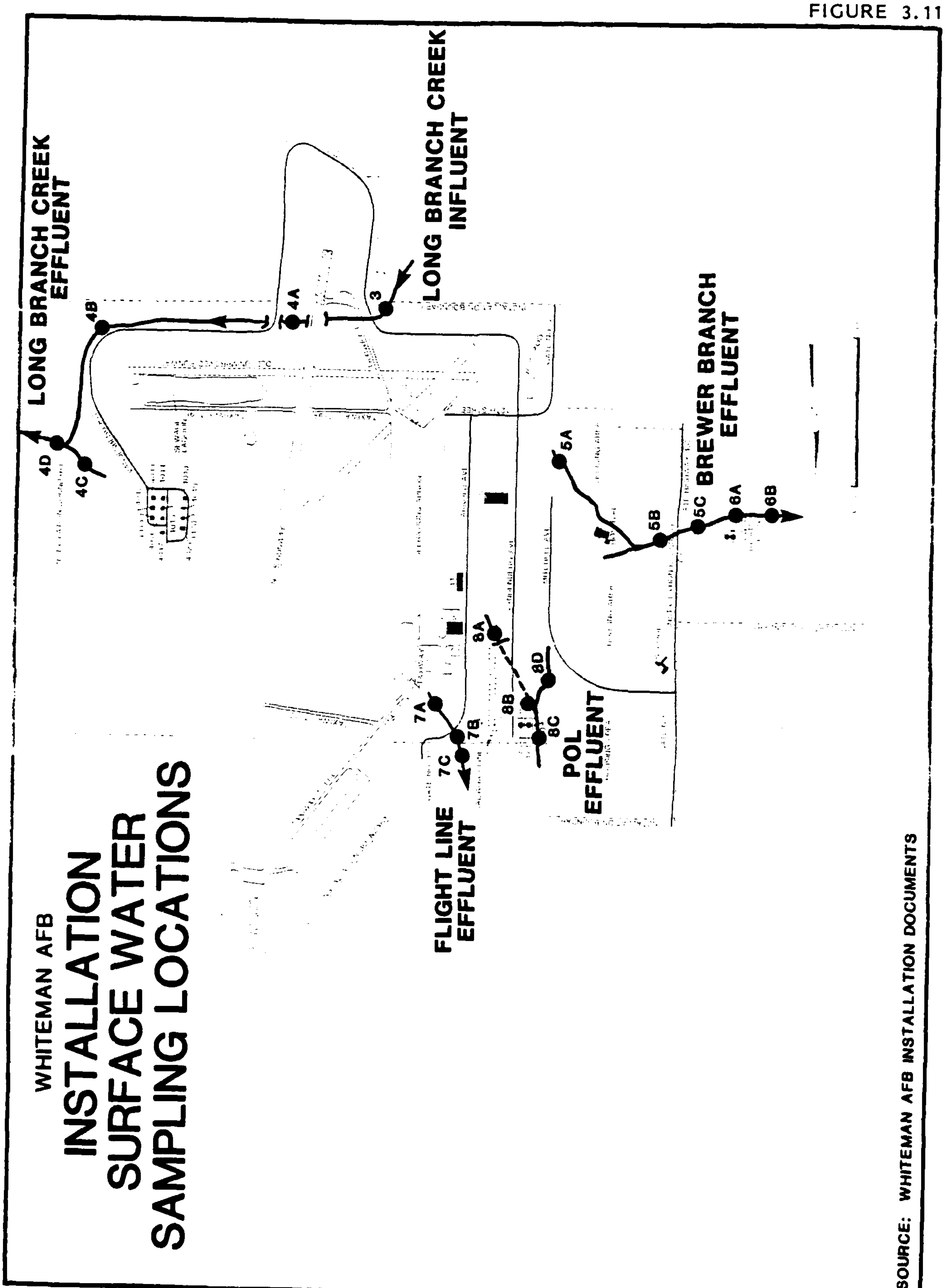
The prairie chicken has been identified as a threatened or an endangered species present on base seasonally. According to the Tab A-1, Section 3.4.2.5 (revised 28 March 1977) significant (30 to 50 birds) populations of the prairie chicken utilize runway areas during the breeding period (March through May).

SUMMARY OF ENVIRONMENTAL SETTING

The environmental setting data reviewed for this investigation indicate that the following elements are relevant to the evaluation of past hazardous waste management practices at Whiteman Air Force Base.

- The mean annual precipitation is 38.4 inches and net precipitation is calculated to be minus 3.2 inches.
- Flooding may be a temporary local problem at the base because of drainage restrictions during heavy rainfall events.
- Base surface soils are typically a thin mantle of fine-grained, slow draining, and low permeability materials. Sandy layers occasionally occur as lenses.

FIGURE 3.11


WHITEMAN AFB
INSTALLATION SURFACE WATER SAMPLING LOCATIONS
LONG BRANCH CREEK EFFLUENT
LONG BRANCH CREEK INFLUENT
BREWER BRANCH EFFLUENT
FLIGHT LINE EFFLUENT
POL EFFLUENT
3
4A
4B
4C
4D
5A
5B
5C
6A
6B
7A
7B
7C
8A
8B
8C
8D
SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS

- An ephemeral shallow aquifer (probably perched seasonally) likely underlies the base and is present at or near land surface. The depth to water in this shallow unit is not known. This aquifer is not known to be a source of water supplies.
- The base is located in a recharge zone for the shallow unit.
- Two aquifers of regional importance (Ordovician and Cambrian systems) underlie the base at great depth (800+ feet). They probably receive recharge from areas in which they are located close to land surface, east of the installation in Pettis County.
- Local municipal water distribution systems and Whiteman AFB utilize the deep aquifers to obtain water resources. It is not known from which aquifer(s) local domestic or agricultural consumers derive water supplies.
- Water obtained from the deep aquifers has been reported to be of good quality.
- Surface water quality exceeds Missouri State Standards on occasions for several parameters, including oil and grease, phenols, ammonia, metals, and pesticides.
- The prairie chicken has been identified as a threatened or endangered species on base.

It may be seen from these key elements that potential pathways facilitating the migration of hazardous waste-related contamination exist. Hazardous waste constituents present at ground surface could be mobilized in overland flow (runoff) or directed to the shallow aquifer. Once in the shallow unit, most contaminants would likely be discharged to local surface waters. The chance for such contamination to reach regional aquifers is considered to be very remote.

SECTION 4
FINDINGS

This section presents information for Whiteman Air Force Base wastes generated by past activity, describes past waste disposal methods, identifies the disposal and spill sites located on the base, and evaluates the potential for environmental contamination.

REMOTE ANNEXES REVIEW

A review of files and records and interviews with present and past base employees were carried out to identify past activities at remote base annexes which could have resulted in the disposal of hazardous waste. Because of the nature of the activities conducted at the remote communications annexes (TVOR, ILS, and repeater sites), namely routine maintenance of equipment, none of these annexes were found to have significant waste generation or disposal activities, past or present. The remote missile sites are discussed further in a later section of this chapter.

PAST SHOP AND BASE ACTIVITY REVIEW

To identify past base activities that resulted in generation and disposal of hazardous waste, a review was conducted of current and past waste generation and disposal methods. This activity consisted of a review of files and records, interviews with present and former base employees, and site inspections.

The sources of most hazardous wastes on Whiteman AFB can be associated with one of the following activities:

- Industrial operations (shops)
- Fire protection training
- Pesticide utilization
- Fuels management

- Waste and hazardous material storage sites
- Aircraft wash rack
- Spills and leaks
- Missile, launch facility, and launch control facility maintenance

The following discussion addresses only those wastes generated on Whiteman AFB which are either hazardous or potentially hazardous. In this discussion a hazardous waste is defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). A potentially hazardous waste is one which is suspected of being hazardous, although insufficient data are available to fully characterize the waste material.

Operations Conducted During Periods of Base Inactivity

From 1947 until 1951, Whiteman AFB was in an inactive status. During that time a "caretaker staff" was assigned to the base, but no significant activity was conducted. As a consequence, no hazardous waste generation is associated with this period.

Industrial Operations (Shops)

Industrial operations at Whiteman AFB are grouped into six major units:

1. Civil Engineering Squadron
2. Combat Support Group
3. Transportation Squadron
4. Supply Squadron
5. 351st Strategic Missile Wing (SMW) Missile Maintenance (FMMS and OMMS)
6. USAF Hospital
7. Tenant Units

From early 1942 through 1947 and then from 1951 to 1962, industrial operations (shops) at Whiteman AFB have included maintenance activities to support aircraft flying missions. These shops maintained, fabricated and repaired components and parts of aircraft and ground equipment. Since 1962, shops have been operated at Whiteman to support both its flying and missile missions. A list of past and present industrial shops was obtained from the Bioenvironmental Engineering Services (BES) files. Information contained in the files indicated those shops which generate hazardous waste and/or handle hazardous materials. A summary review of the shop files is shown in Appendix E, Master List of Industrial Shops.

For those shops that generated hazardous waste, key personnel within the base maintenance support functions were interviewed. A timeline of disposal methods was established for major wastes generated. The information from interviews with base personnel and base records has been summarized in Table 4.1. This table presents a list of building locations as well as the waste material names, current or most recent estimates of waste quantities, and disposal method timeline. If significant changes in generation rates with time were found, these changes are noted under the waste quantity heading. Many of the disposal methods were identified from information obtained from personnel currently at the base. Other disposal methods were identified from interviews with retired base personnel and from base records. The waste quantities shown in Table 4.1 are based on verbal estimates provided by shop personnel at the time of the interviews. The shops that have generated no hazardous waste are not listed in Table 4.1.

In Table 4.1, the term OBC refers to off-base contractor, which includes the following off-base disposal methods:

1. Resale/recycle/reclamation
2. Off-base disposal by contract
3. Informal off-base disposal arrangements not involving contracts.

Since 1980, hazardous waste manifests have been maintained for all hazardous wastes transported off-base.

A search of shop files, real property records, and interviews with base personnel have provided limited information about shop activities, hazardous waste generation rates and disposal practices for the period from 1942 to 1947 when the base supported a glider/training mission. Industrial activities increased significantly when the base reopened in 1951 and moved towards the arrival of jet-powered aircraft in 1954.

TABLE 4.1

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF WASTE MANAGEMENT 1940 1950 1960 1970 1980
CIVIL ENGINEERING SQUADRON				
ENTOMOLOGY	705	EXCESS PESTICIDES	<10 GALS./MO.	1942 1947 1951 APPLIED TO EARTH INSIDE POL DIKES
		EMPTY CONTAINERS	10 CONTAINERS/MO.	RINSED, TO GENERAL BASE REFUSE
LIQUID FUELS MAINTENANCE	93	WASTE FUEL AND ISOPROPYL ALCOHOL	1 GAL./MO.	OBC; OBC
		TANK CLEANING SLUDGE	5 GALS./YR.	LAND TREATMENT
PAINT SHOP	705	PAINT RESIDUES	10 GALS./MO.	LANDFILL; LANDFILL/OFF-BASE REFUSE CONTRACTOR; 1979 OBC
		"WATERFALL" SLUDGE	1 GAL./MO.	LANDFILL; LANDFILL/ OFF-BASE REFUSE CONTRACTOR
ROADS & GROUNDS	T-9	WASTE OIL	8 GALS./MO.	OBC; OBC
POWER PRODUCTION	705	BATTERY ACID	<2 GALS./MO.	NEUTRALIZED TO SANITARY SEWER
		ANTIFREEZE	4 GALS./MO.	STORM DRAIN; 1975 OBC
		WASTE OIL	8 GALS./MO.	OBC; OBC
EXTERIOR ELECTRIC		PCB TRANSFORMERS	6 TO 8 ON HAND	OBC; OBC

KEY

———— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - - - ESTIMATED TIME-FRAME DATA BY SHOP PERSONNEL

OBC - OFF-BASE CONTRACTOR

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF WASTE MANAGEMENT 1940 – 1950 – 1960 – 1970 – 1980
COMBAT SUPPORT GROUP				
AUTO HOBBY SHOP	650	WASTE OIL	150 GALS./MO.	1942 OBC 1947; 1951 OBC
AV/PHOTO LAB	1424	PHOTO CHEMICALS	20 GALS./MO.	SANITARY SEWER
		RECOVERED SILVER	<1 LB./MO.	1970 OBC
TRANSPORTATION SQUADRON				
ALLIED TRADES	S-159	SOLVENTS	55 GALS./MO.	1951 OBC
		"WATERFALL" PAINT RESIDUE	<2 GALS./MO.	OBC
VEHICLE MAINTENANCE	S-159	OILS & GREASES	150 GALS./MO.	OBC/FPTA; 1980 OBC
		DEGREASERS	40 GALS./MO.	OBC/FPTA; OBC
HEAVY EQUIPMENT MAINTENANCE	T-9	WASTE OIL	200 GALS./MO.	OBC/FPTA; OBC
		SOLVENTS	55 GALS./MO.	OBC/FPTA; OBC
		ANTIFREEZE	50 GALS./MO.	STORM DRAIN; 1975 OBC
BATTERY SHOP	S-159	OLD BATTERIES	<5 BAT./MO.	OBC; OBC
		BATTERY ACID	15 GALS./MO.	NEUTRALIZED TO SANITARY SEWER
		ANTIFREEZE	500 GALS./MO.	STORM DRAIN; 1975 OBC
REFUELING MAINTENANCE	121	SOLVENT	4 GALS./MO.	OBC

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - ESTIMATED TIME-FRAME DATA BY SHOP PERSONNEL

OBC - OFF-BASE CONTRACTOR

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF WASTE MANAGEMENT 1940 1950 1960 1970 1980
SUPPLY SQUADRON				
FUELS LAB	87	CONTAMINATED FUELS	<10 GALS./MO.	1954 FIRE TRAINING
351st FIELD MISSILE MAINTENANCE SQUADRON (FMMS)				
CORROSION CONTROL	T-30	PAINT SLUDGES	2 GALS./MO.	1964 LANDFILL/OFF-BASE REFUSE CONTRACTOR
FACILITY MAINTENANCE	S-41	ETHYLENE GLYCOL	5 GALS./MO.	OBC
REFRIGERATION SHOP	S-43	SODIUM CHROMATE SOLUTION	50 GALS./YR.	REDUCTION/ SANITARY SEWER, OBC
		POTASSIUM HYROXIDE SOLUTION	10 GALS./MO.	NEUTRALIZED TO SANITARY SEWER
BATTERY SHOP	S-43	POTASSIUM HYDROXIDE SOLUTION	5 GALS./MO.	NEUTRALIZED TO SANITARY SEWER
		BATTERY ACID	1 GAL./MO.	NEUTRALIZED TO SANITARY SEWER
		OLD BATTERIES	1 BAT./MO.	OBC
VEHICLE CONTROL SHOP	S 43	ANTIFREEZE	55 GALS./YR.	OBC
		SOLVENTS	110 GALS./YR.	OBC

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

------ ESTIMATED TIME-FRAME DATA BY SHOP PERSONNEL

OBC - OFF-BASE CONTRACTOR

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF WASTE MANAGEMENT (1940–1980)
351st ORGANIZATIONAL MISSILE MAINTENANCE SQUADRON (OMMS)				
ELECTROMECHANICAL TEAM AND MISSILE MAINTENANCE TEAM	S-41	ELECTRICAL MISSILE TRANSFORMERS AND CAPACITORS	5/YR.	1964 OBC (confirmed) → 1981 OVERPACK/OBC (confirmed) →
USAF HOSPITAL				
DENTAL CLINIC	2032	MERCURY AMALGAM	31 LBS./YR.	1951 OBC (estimated → confirmed) →
DENTAL X RAY	2032	PHOTO CHEMICALS	5 GALS./MO.	SANITARY SEWER (estimated → confirmed) →
		SILVER RECOVERY	<1 LB./MO.	1970 OBC (confirmed) →
MEDICAL LAB	2032	PROCESSED BODY FLUIDS	<2 LBS./DAY	AUTOCLAVE (estimated → confirmed) →
		VARIOUS LAB WASTES	5 GALS./MO.	SANITARY SEWER (estimated → confirmed) →
MEDICAL X-RAY	2032	PHOTO CHEMICALS	45 GALS./MO.	SANITARY SEWER (estimated → confirmed) →
		SILVER RECOVERY	<1 LB./MO.	1970 OBC (confirmed) →

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - - ESTIMATED TIME-FRAME DATA BY SHOP PERSONNEL

OBC - OFF-BASE CONTRACTOR

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF WASTE MANAGEMENT (1940 – 1950 – 1960 – 1970 – 1980)
MO. ARMY NATIONAL GUARD (TENANT)	T-54	ENGINE OIL	100 GALS./YR.	1977 OBC
		HYDRAULIC FLUID	3 GALS./YR.	OBC
		CARBON REMOVER	55 GALS./YR.	OBC
		PAINT RESIDUES	<5 GALS./YR.	OBC
		TRICHLOROETHYLENE	3 GALS./YR.	O/W SEPARATOR/SANITARY SEWER
		CLEANING SOLVENT	600 GALS./YR.	ANG WASH RACK TO O/W SEPARATOR/SANITARY SEWER
37th AEROSPACE RESCUE AND RECOVERY SERVICE (ARRS), DET. 9, (TENANT)				
A.G.E. SHOP	T-9	SOLVENT CLEANERS	25 GALS./MO.	1953 FLOOR DRAIN TO STORM SEWER
		HYDRAULIC FLUID	1 GAL./MO.	OBC
		WASTE OIL	25 GALS./MO.	OBC
CORROSION CONTROL	S 41	PAINT SLUDGES	<2 GALS./MO.	LANDFILL/OFF-BASE REFUSE CONTRACTOR
HELICOPTER MAINTENANCE	T 4	WASTE FUEL	10 GALS./MO.	EARLY 60's STORM SEWER 1976 OBC
		SOLVENTS	30 GALS./MO.	OBC
		HYDRAULIC FLUID	20 GALS./MO	OBC

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - ESTIMATED TIME FRAME DATA BY SHOP PERSONNEL

OBC - OFF BASE CONTRACTOR

Most of the aircraft support buildings (and hence the shop buildings) were either built or refurbished during the early 1950's.

Aircraft support shops have for the most part remained in their present location for a number of years. Base-support shops, however, such as those in the Civil Engineering Squadron, have moved several times. Those shops with a missile-support mission were established between 1962 and 1964. Silver-recovery from photo chemical wastes on base began in about 1970.

The wastes generated in shops at Whiteman AFB consist mainly of contaminated jet fuel (JP-4), waste oils and lubricants, acid and alkaline cleaning solution, solvents, paint strippers, and paint sludges.

The waste petroleum products are currently removed through the Defense Property Disposal Office (DPDO) by an off-base contractor. These wastes have been either removed by off-base contractors or burned in fire training exercises for many years, probably since the beginning of the base.

Waste acids and alkaline solutions generated indoors have generally gone to the sanitary sewers in either a diluted or neutralized state. Similar wastes generated outdoors have run off into the storm sewer system.

Liquid solvents and paint strippers have typically been removed by an off-base contractor. Paint sludges have usually been considered an ordinary refuse, i.e., put into the landfill or similarly disposed of.

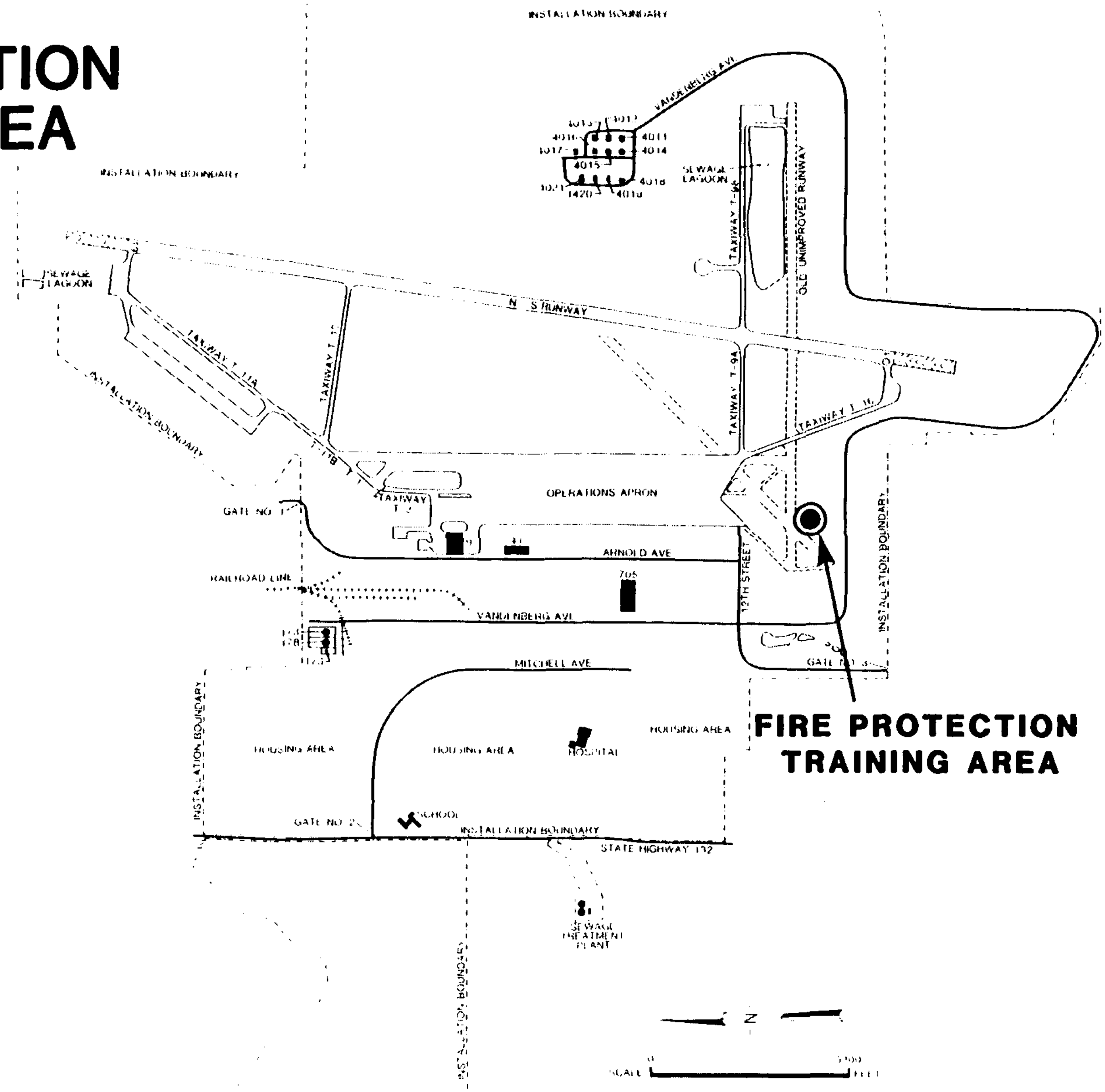
A major tenant unit at Whiteman AFB is the Missouri Army National Guard. This unit was activated at Whiteman in 1976, and maintains approximately 25 helicopters at the base. Hazardous wastes associated with this unit include engine oil, cleaning solvents, carbon remover, and small volumes of several other materials. Disposal methods for these wastes are shown in Table 4.1.

Fire Protection Training

The fire department at Whiteman AFB has operated one fire protection training area during the entire period of operation of the base. Fire extinguising agents have included water, AFFF, and Purple K. The site location is depicted in Figure 4.1.

The fire protection training area (FPTA) is located at the southern end of the base, north of Vandenberg Avenue and south of the operations

WHITEMAN AFB
FIRE PROTECTION TRAINING AREA



SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS

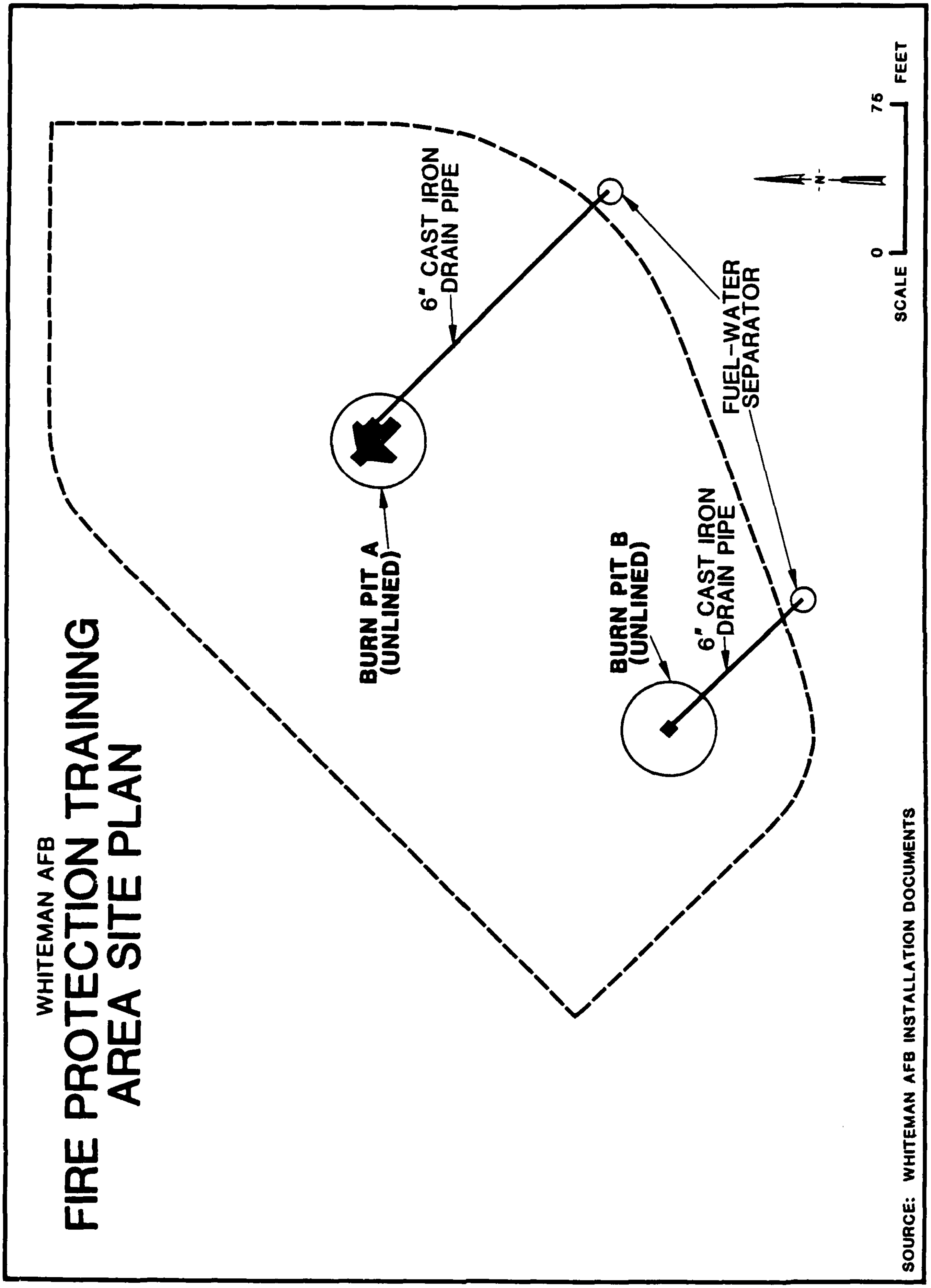
apron. The site was activated at some time during the early 1940s. The site consists of a mockup of an aircraft fuselage, a small burn pit ("Burn Pit B"), two concrete-lined oil-water separators, and one 2,000-gallon steel fuel storage tank, as shown in Figure 4.2. Waste fuel is pumped from the storage tank through underground lines to a hydrant system containing four discharge nozzles at the mockup and one discharge nozzle at Burn Pit B. The drainage and collection system consists of six-inch diameter cast iron drain pipes which are connected to two open-top concrete-lined oil-water separators, one serving the mockup and the other serving Burn Pit B. The fuel phase from the separators is manually collected and transferred to the waste fuel storage tank. The aqueous phase from the separators is released to drainage ditches which combine to form a single drainage ditch which discharges to Long Branch Creek. Present burn frequency is approximately twenty times per year. Past burn frequency is uncertain but was probably less than the present. Prior to late 1977, no waste collection and separation system was in operation at the site.

Visual examination of the area during the site visit indicated surficial contamination and a noticable fuel odor in the burn areas, the separator area, and along the entire length of the drainage ditch. Vegetative stress was noted near the edges of the drainage ditches. Because of the kind of operations performed at the site and the visual evidence of contamination, a potential for contaminant migration exists for the site.

<u>Pesticide Utilization</u>

Pest management has been conducted at Whiteman AFB by the Civil Engineering Squadron since the base was constructed. Insecticide and herbicide applications have been performed by the Entomology Shop. The pest management program entails routine and specific-job-order chemical application and spraying. No aerial spraying has been conducted at Whiteman AFB. Prior to October 1983 the Entomology Shop was located in Building 163. Pesticides are presently stored in Building 707; storage prior to 1981 was at Building 162. Pesticides on-hand at the time of this study are listed in Appendix D, Table D.1. A discussion of pesticide disposal is presented in a later section of this chapter.

FIGURE 4.2



WHITEMAN AFB
FIRE PROTECTION TRAINING AREA SITE PLAN

Beginning in 1980, the pesticide chlordane was used in housing areas for termite control. Subsequent analyses of surface water discharges fom the base have shown detectable concentrations of this pesticide. The locations of the housing areas which have been treated with chlordane are shown in Figure 4.3. Because of the nature of the pesticide used and the indications of possible water contamination, a potential for contaminant migration exists at this site.

Fuels Management

During the early period of base operations (1941-1947), AVGAS was transported on base by truck to service T-101 aircraft. The existing hydrant system was installed in 1952 when the base was renovated by SAC. There are three above ground fuel tanks, two of approximately 30,000 barrel capacity and one of 10,000 barrel capacity. One tank contains unleaded MOGAS and the other two have been pickled. Almost all of the JP-4 storage facilities have been pickled, although the hydrant system remains active. The pickling took place in the mid 1960's when the primary mission of the base became missile-related. Currently less than 70,000 gallons of JP-4 are in storage at the base in twelve underground tanks, at the Fuel Management Facility. No leakage from these tanks has been reported. A list of fuel tanks at Whiteman AFB is presented in Appendix D, Table D.4.

Waste and Hazardous Material Storage Sites

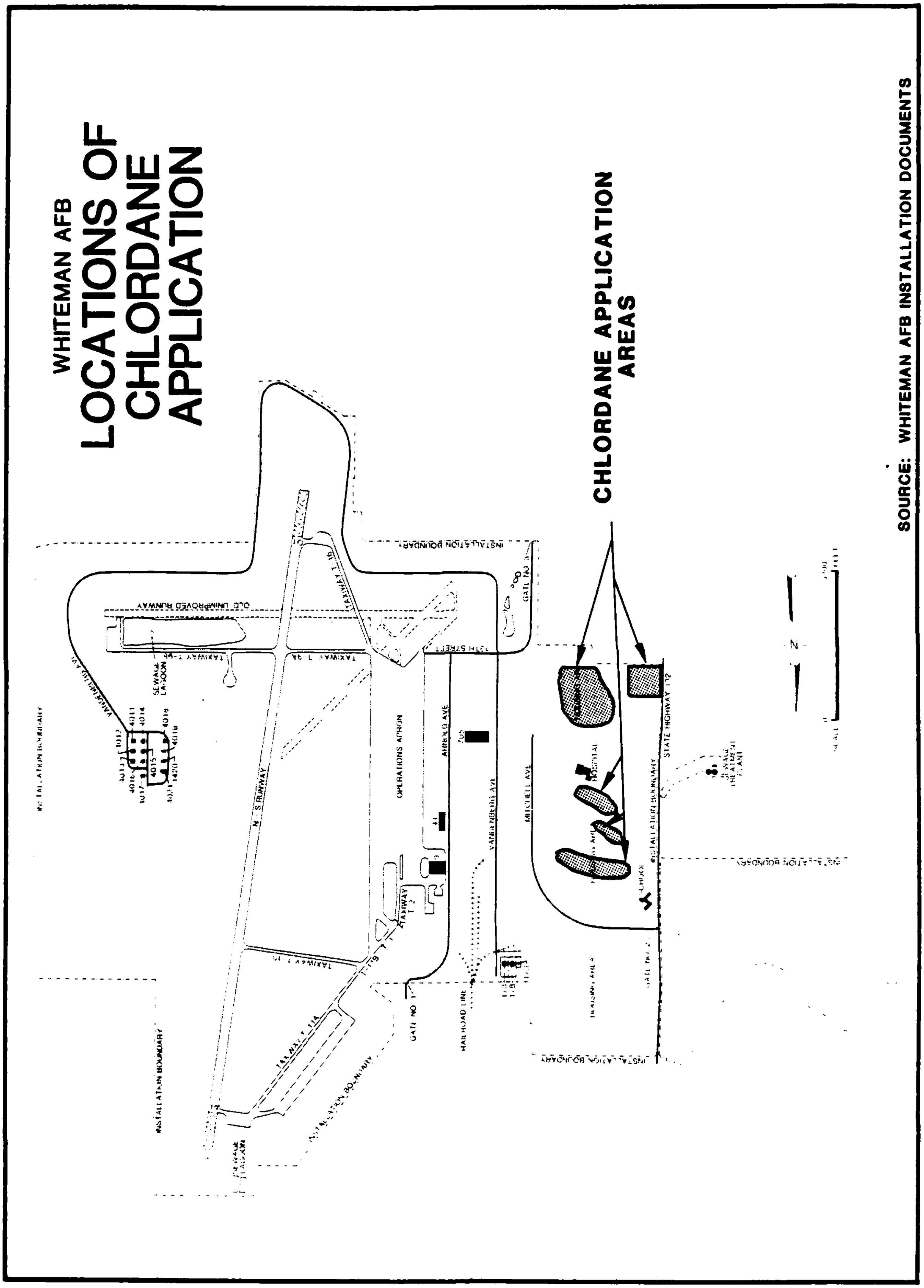
Wastes and hazardous materials are stored at several locations on Whiteman AFB, as shown in Table 4.2. The outdoor drum storage areas were toured during the site visit; most of the facilities exhibit visual contamination of the surface material (asphalt, gravel, or concrete).

Only one area of significant contamination of a waste storage site was noted. Immediately east of Building T-9 is a drum storage area of about 20 drum capacity at which numerous spills and leaks of wastes, which include hydraulic fluids and oils, have occurred. The location of this site is shown in Figure 4.4. Discharges into a nearby storm drain have reportedly occurred on occasion. Because of the proximity of storm drainage elements, a potential for environmental contamination is associated with this site.

The permitted hazardous waste storage facility, Facility Number 128, is an outdoor fenced storage area with diked concrete floor and

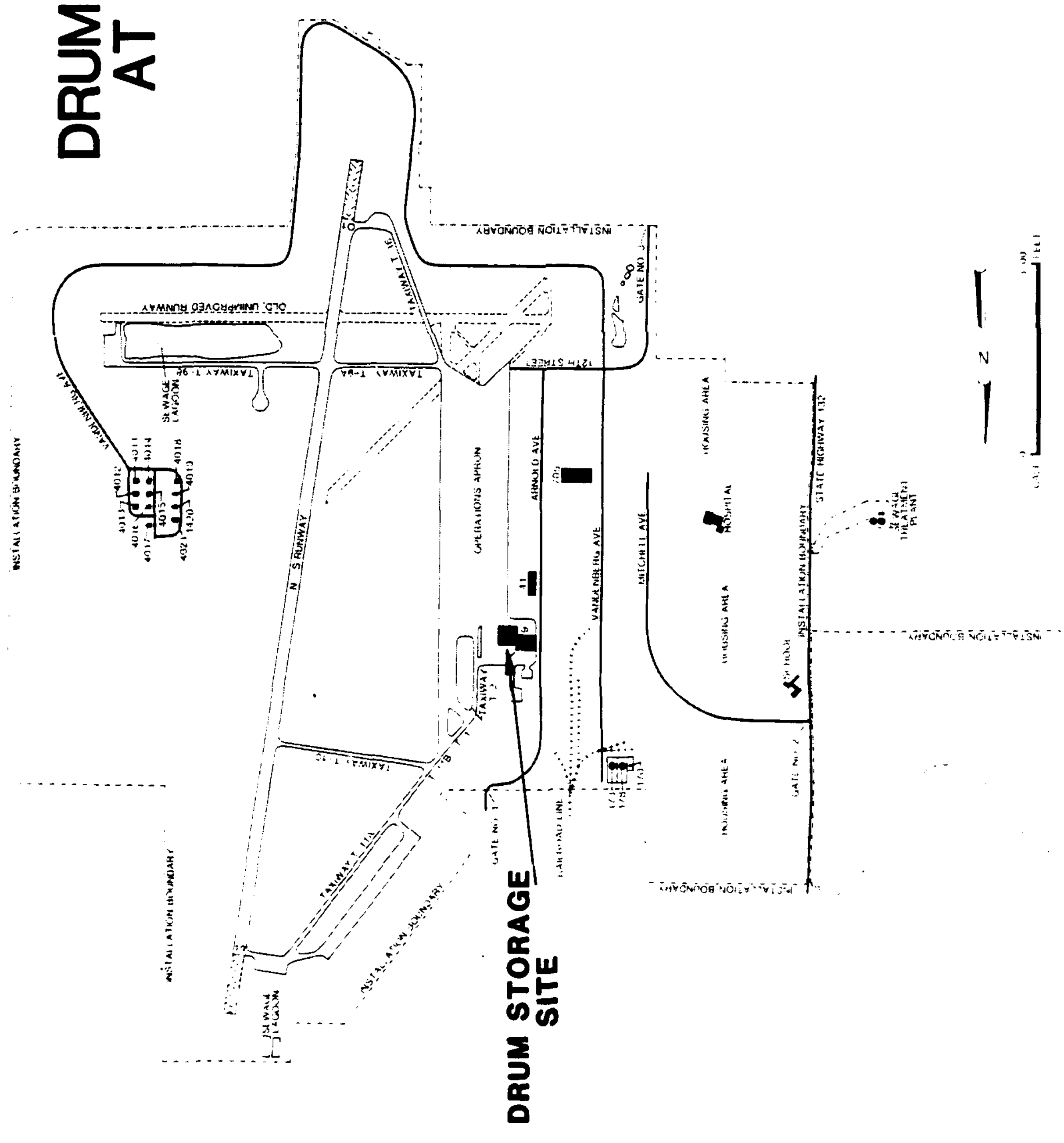
TABLE 4.2
WASTE AND HAZARDOUS MATERIAL STORAGE AREAS

Location	Storage Type	Volume	Material
Building 8	Aboveground tank.	5,000 gal	Waste oil.
Hangar 4	Drum storage, fenced, roofed.	10 drums	Unused oils, lubricants.
T-9	Drum storage, fenced, no roof.	20 drums	Unused and waste oils, lubricants, solvents, kerosine.
Building 16	Concrete block building, roofed, concrete pad.	--	Unused hazardous materials.
Building 52	Drum storage, no roof, gravel base.	30 drums	Unused oils, lubricants, solvents.
Building 159	Drum storage, no roof, fenced, gravel base.	15 drums	Unused and waste oils, lubricants, solvents.
Building 44	Drum storage, no roof, fenced, gravel base.	20 drums	Unused and waste oils, lubricants, solvents.
Building 166	Drum storage, no roof, fenced, asphalt base.	5 drums	Unused and waste oils, lubricants, solvents.
Facility 128 (Hazardous Waste Storage Facility)	Drum storage, no roof, fenced, concrete base with diking, drains to oil-water separator.	30 drums	Shop wastes, waste solvents, waste sodium chromate.
Building 166	Inside building, concrete floor, berms.	--	PCB materials.
Building 2003	Aboveground tank	--	Lime-alum sludge.
Building 707	Inside building, concrete floor with diking.	--	Pesticides and paints.
Facility 4011 through 4021	Earthen igloos.	--	Munitions



ES ENGINEERING-SCIENCE

WHITEMAN AFB
DRUM STORAGE SITE AT BUILDING T-9



SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS

drains which discharge to an oil-water separator. The facility is of adequate size, and is secure against unauthorized entry. This facility is a recent addition having been completed since 1980. Prior to its completion, most wastes were accumulated at their point of generation.

Aircraft Wash Rack

An aircraft wash rack was operated prior to the late 1970s between Building 4 and Building 9, adjacent to the north end of the operations apron. The facility was used for degreasing aircraft, primarily B-47 aircraft during the 1950's and 1960's. The drainage from the cleaning operation flowed through a pipe to a nearby oil-water separator, from which the aqueous phase discharged to Clear Fork Creek through a storm drain. The solvent used in the operation was predominantly PD-680, which dissolved in the water and was discharged with the water. Vegetative stress reportedly was present in the area around the wash rack during its period of service. Complaints from downstream residents reportedly were registered during the 1950's and 1960's.

Spills and Leaks

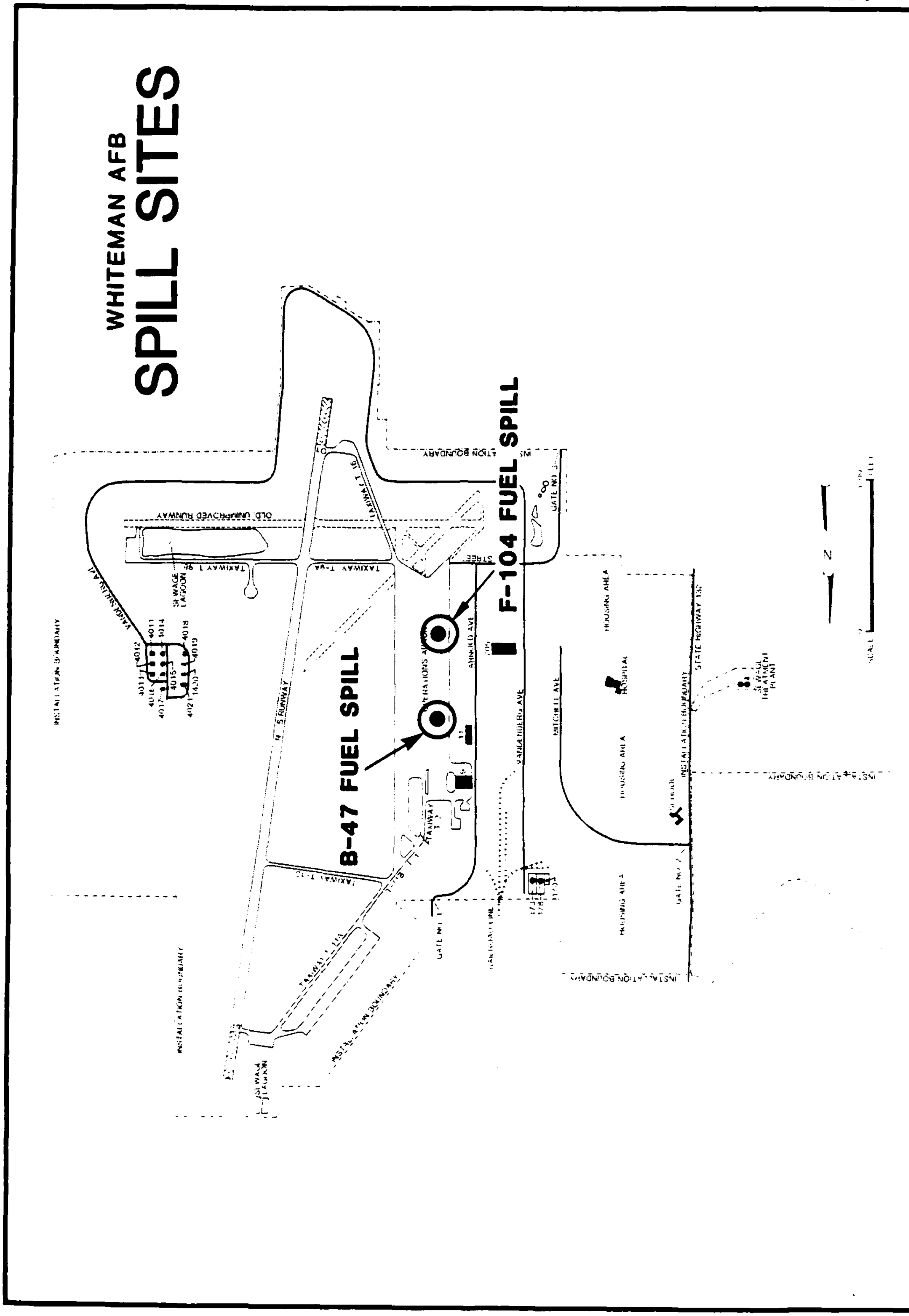
Numerous small spills of fuels and oils were confirmed by base records and interviews with base personnel. These spills occured onto paved areas or inside shop areas and were contained with absorbent materials or washed into the drainage system to an oil-water separator. As a result, no potential for environmental contamination is associated with these small spills.

Several significant spills of hazardous materials have been confirmed by interviews with base personnel. The locations of these sites are shown in Figure 4.5.

A B-47 bomber aircraft burned on the operations apron adjacent to Building 39 sometime during the late 1950s or early 1960s. Undetermined quantities of fuel were released from the aircraft and entered the storm drain system, ultimately being discharged Brewer Branch. No potential for present environmental contamination is associated with this event.

In 1977, a fighter aircraft (F-104) burned on the operations apron adjacent to Building 52. Undetermined quantities of fuel were released from the aircraft and entered the storm drain system, ultimately being discharged to the creek. No potential for present environmental contamination is associated with this event.

FIGURE 4.5



SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS

Missile, Launch Facility, and Launch Control Facility Maintenance

The Whiteman Air Force Base Missile Wing is located in west central Missouri. The Wing consists of 15 Launch Control Facilities (LCF's) and 150 Launch Facilities (LF's) for 150 Minuteman II Intercontinental Ballistic Missiles (ICBM). Each LCF controls 10 LF's. Maintenance of the LCFs and LFs is performed by the missile maintenance crew, a unit of the base Civil Engineering Squadron. Chemicals which are potentially hazardous to the environment are present at LCF and LF sites. These chemicals are described in the following paragraphs.

A main diesel fuel tank which holds 12,000 gallons of fuel is located 60 feet underground at each LCF site. The support building at each LCF has a diesel tank which contains 2,500 gallons of fuel. The main diesel tank feeds a "day tank" which holds 165 gallons of fuel and is located in the equipment bay.

An aboveground tank at each LCF holds 2,000 gallons of MOGAS. A lube oil tank which contains 65 gallons of 30 weight oil is located near the generator. Ethylene glycol is used as a coolant and Freon 502 and Freon 12 are used as refrigerants at the LCF sites. Methyl ethyl ketone (MEK) and PD-680 used to clean the diesel fuel filters on the generators.

At the LF sites a main diesel fuel tank has a capacity of 13,775 gallons and a "day tank" holds 315 gallons. The missiles themselves are propelled with solid fuel which is not loaded or handled at these facilities. A sodium chromate solution is used in the missile guidance system for cooling; the cooling system on each missile holds 1.5 gallons of the solution. A lube oil tank near the generator holds 60 gallons of 30-weight oil. In addition, Freon 502, MEK, and PD-680 are used for the same purposes as at LCF sites. Batteries located at both LCF and LF sites are alkaline electrolyte nickel-cadmium batteries containing potassium hydroxide (KOH). Twelve lead acid batteries are located in the launchers at each site.

At each LCF and LF a sump pump is located at the base of the underground facility. At the LCF sites, the sump discharges into a sewage lagoon on the LCF grounds, with the exception of the base LCF (O-1). Each sewage lagoon is about fifty feet in diameter and has a depth of about five feet. The lagoons are unlined and have an overflow pipe. In addition sewage from the support building is discharged into the lagoon. At LF sites the sump discharge pipe is about five feet from the launch support building; the discharge runs directly onto the gravel covering the ground.

Interviews and visual inspections of selected LF and LCF sites were performed to determine the potential environmental impact of activities at typical sites. Fourteen sites were toured as part of the on-site visit; the nine LCF's were A-01, G-01, H-01, I-01, J-01, K-01, L-01, N-01, and O-01. The five LF's visited were A-07, A-08, A-11, N-05, and N-08.

Activities associated with the fuel tanks at the missile sites were noted. Interviews with missile maintenance personnel indicated that infiltration of water into diesel tanks has occurred on several occasions. When such infiltration has been noted, the water has been removed to 55-gallon drums by Civil Engineering Maintenance personnel and the drums transported to the base for disposal. Small volumes of water have been discharged onto the ground. On one occasion (November 1980) at site N-1, about 300 gallons of fuel from an underground storage tank contaminated the exhaust shaft. The fuel was removed from the shaft during the spring of 1981 and the fuel tank was replaced. The 300 gallons of spilled fuel was transported to the base and was burned in the fire protection training area. The areas surrounding the aboveground MOGAS tanks were inspected at the sites visited; no indications of major spills were evident and interviewees reported that only minor spills such as normally found in refueling operations have occurred.

Waste lagoons at LCF sites toured were inspected and interviewees were questioned about lagoon operations. At sites H-1 and N-1, farm ponds are situated off the sites within 50 and 300 feet, respectively, of the lagoons. At site N-1, the pond is at a lower elevation than the lagoon and so the potential for drainage or overflow from the lagoon to the pond is noted. Several instances of chemical additions to selected lagoons to reduce odors or kill algae were noted. During 1983, about five pounds of Aquazene (Ciba-Geigy) was added to each remote site lagoon (A-1 through N-1) on a one-time basis as an algicide.

Brine line leakage has been noted at some LCF sites. Specifically, at site H-1, past piping system clogs have resulted in releases of ethylene glycol onto the building floors at the rate of about one gallon per day. Replacement of the affected piping eliminated the problem.

Site tours of LF locations listed previously were conducted. The LF sites are unmanned facilities, so interviews with LCF personnel were the sources of most information about LF operations and activities. At the LF sites inspections were made of the sump discharge (aboveground) and the support building. At sites A-11 and N-5, the gravelled area near the sump discharge was discolored. Minor leakage of lubrication oil within the support facility was noted at sites A-7, A-8, A-11, and N-5; the leakage appeared to be less than one quart. Sodium chromate coolant leaks are reported to occur infrequently and are removed by PREL shop personnel; the coolant and cleanup materials are placed in drums for transportation to the base.

Other potential areas of contamination for both LCF and LF sites are electrical distribution transformers which may contain polychlorinated biphenyls (PCBs) and the aboveground gravelled areas, which are routinely sprayed with a weed killer during the growing season. Surface-water contaminated by runoff resulting from use of weed killers at LF sites has been assessed and is being corrected by separate base actions.

DESCRIPTION OF PAST ON-BASE TREATMENT AND DISPOSAL

The facilities on Whiteman AFB which have been used for the management and disposal of waste can be categorized as follows:

- Landfills
- Hardfill Disposal Areas
- Surface Impoundments
- Explosive Ordnance Disposal Area
- Low-level Radioactive Waste Burial Sites
- Incinerators
- Sanitary Wastewater Treatment System
- Storm Water Drainage System
- Oil-Water Separators
- Excess Pesticide Disposal Area
- Sodium Chromate Treatment Areas

These facilities are discussed individually in the following subsections.

Landfills

On-base landfills at Whiteman AFB have been used for disposal of non-hazardous solid wastes and some industrial waste materials. Landfills were known to have operated at five locations as shown in Figure 4.6. A summary of the pertinent information for those landfills is presented in Table 4.3.

Landfill No. 1

Landfill No. 1 was operated in the old CE compound area, near the area presently occupied by Buildings 160 and 165. The landfill was operated during the 1940s, but no exact dates could be determined. The exact boundaries of the fill area are unknown, but it was reported that landfill material was uncovered while preparing for foundation work on both Building 160 and 165 and while placing utilities to these buildings. It was reported that old glider parts as well as refuse materials were disposed of in this landfill. No surficial evidence remains at the present time to indicate the boundaries of the landfill.

Landfill No. 2

Landfill No. 2 operated for a very short time during the 1950s at a location southeast of the fire protection training area and south of Vandenberg Avenue. The exact boundaries, period of operation, and material disposed are unknown, but it was reported that the landfill operated only a few months because of complaints from private citizens who lived across State Highway AB from the area. It is assumed, based upon an assessment of base activities, that routine refuse was disposed of in Landfill No. 2 in a trench-and-fill operation.

Landfill No. 3

Landfill No. 3, located south of the fire protection training area and north of Vandenberg Avenue, was active for a short time period (one year or less). Its period of use is known only to be between the late 1940s and mid-1950s. Routine base refuse was discarded in the landfill in a trench-and-fill operation.

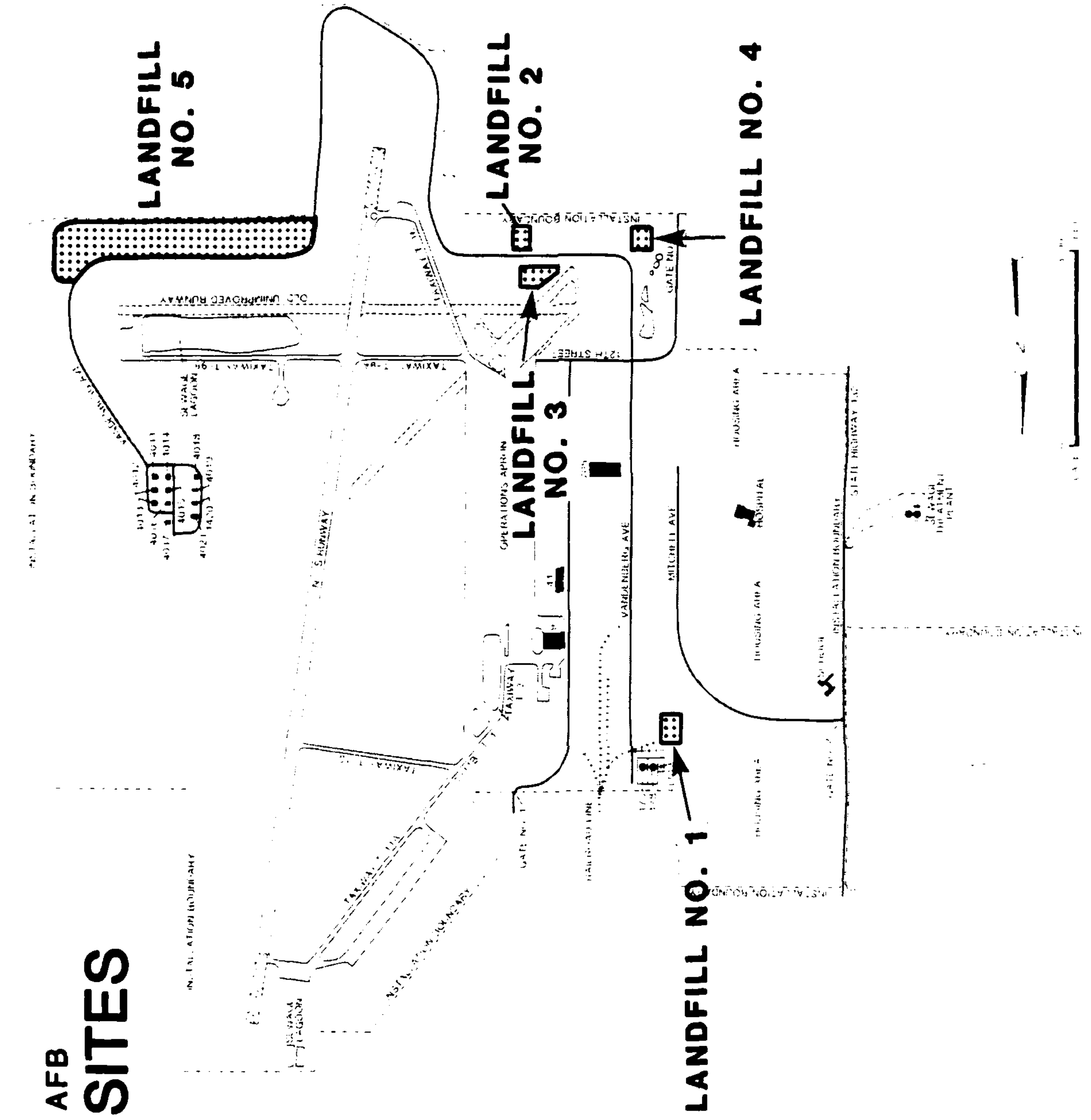
TABLE 4.3

SUMMARY OF LANDFILL DISPOSAL SITES

Landfill Designation	Operation Period[1]	Approximate Size (Acres)	Type of Waste	Method of Operation	Closure Status	Surface Drainage
No. 1	1940's	2 (est)	General refuse, glider parts	Trench and fill	Closed; present site of Bldgs. 160, 165	To unnamed tributary of Clear Fork
No. 2	1950's (less than one year)	1	General refuse	Trench and fill	Closed; covered; presently an open field	To Long Branch
No. 3	1940's - mid 1950's (less than one year)	2	General refuse	Trench and fill	Closed; covered; presently an open field	To Long Branch
No. 4	1957-58	1	General refuse	Trench and fill	Closed; covered; presently an open field	To small on-base ponds, to Brewers Branch
No. 5	1970-77	40	General refuse, hardfill, brush, drummed wastes	Trench and fill	Closed; partially coveredwith undergrowth. Hardfill rubble visible at surface and at creek banks	To Long Branch

[1]Base refuse was disposed by off-base contractors during time periods not covered by landfill operations.

WHITEMAN AFB
LANDFILL SITES



SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS

Landfill No. 4

Landfill No. 4, located at the southwest corner of the base near the ponds and Gate 3, was operated for a short time during 1957 and 1958. The landfill is known to have been small, although exact boundaries and dimensions are unknown. It is believed that routine refuse was discarded in this landfill, likely in a trench-and-fill operaton.

Landfill No. 5

Landfill No. 5, the most recently operated landfill on the base, is the largest. This landfill, located at the southeast corner of the base south of Vandenberg Avenue, was operated from 1972 until 1977. This landfill was about 1/2-mile long (west to east) and ranged from 300 to 500 feet wide. Long Branch Creek flows near the northern edge of the fill area. The landfill was a trench-and-fill operation, with trenches running predominantly north-south. Base refuse, as well as hardfill and other rubble, was disposed of in this landfill. At the present time, the fill surface is moderately levelled with sparse vegetation and numerous rubble areas still partially visible.

Based on interviews with base personnel, examination of photographs taken during and after its period of service, and present day site observations, it was determined that approximately thirty 55-gallon drums of waste oils and other waste chemicals were disposed of in the landfill during its period of use. Visible drums were removed for off-base disposal after 1981, but others were inaccessible and hence were not removed.

Other Potential Landfill Areas

On several occasions a single interviewee indicated that other landfills or disposal areas may have operated for short time intervals, primarily during the 1940s. However, confirmation by other interviewees was not obtained, so these sites are mentioned by estimated location without further description. One interviewee mentioned the existence of a landfill area just west of the jail, near North Barksdale Road. A second interviewee mentioned that a small landfill had existed just west of LCF site O-1 on the base. A landfill may have been operated just west of the Officers' Club in an open field. Also, a landfill and drum disposal area was reported by one interviewee to exist north of the ponds at the southwest of the base. None of these areas at present shows any surficial indication of the existence of a disposal site.

Off-Base Refuse Disposal

Since significant time gaps appear in the on-base landfill operations, it was instructive to determine the disposition of refuse during these times. General refuse from the base operations has been transported off-base by a contractor intermittently since the base was activated; since 1977 all refuse has been disposed of by an off-base landfill contractor.

Hardfill Disposal Areas

Four areas on Whiteman AFB are known to have been used for disposal of construction rubble, brush, and other hardfill. There is no evidence of any hazardous waste disposal associated with these hardfill areas. These areas are shown on Figure 4.7. A brief description of each site is presented in the following discussion.

Hardfill Site No. 1

Hardfill Site No. 1 is located southeast of the Whiteman AFB Hospital at a distance of approximately 200 yards from the hospital building. It was reported that construction rubble from the hospital site was disposed of in an area of about 200 square yards. Presently the site is not used for disposal; however, rubble is still visible in sparsely vegetated areas of the site.

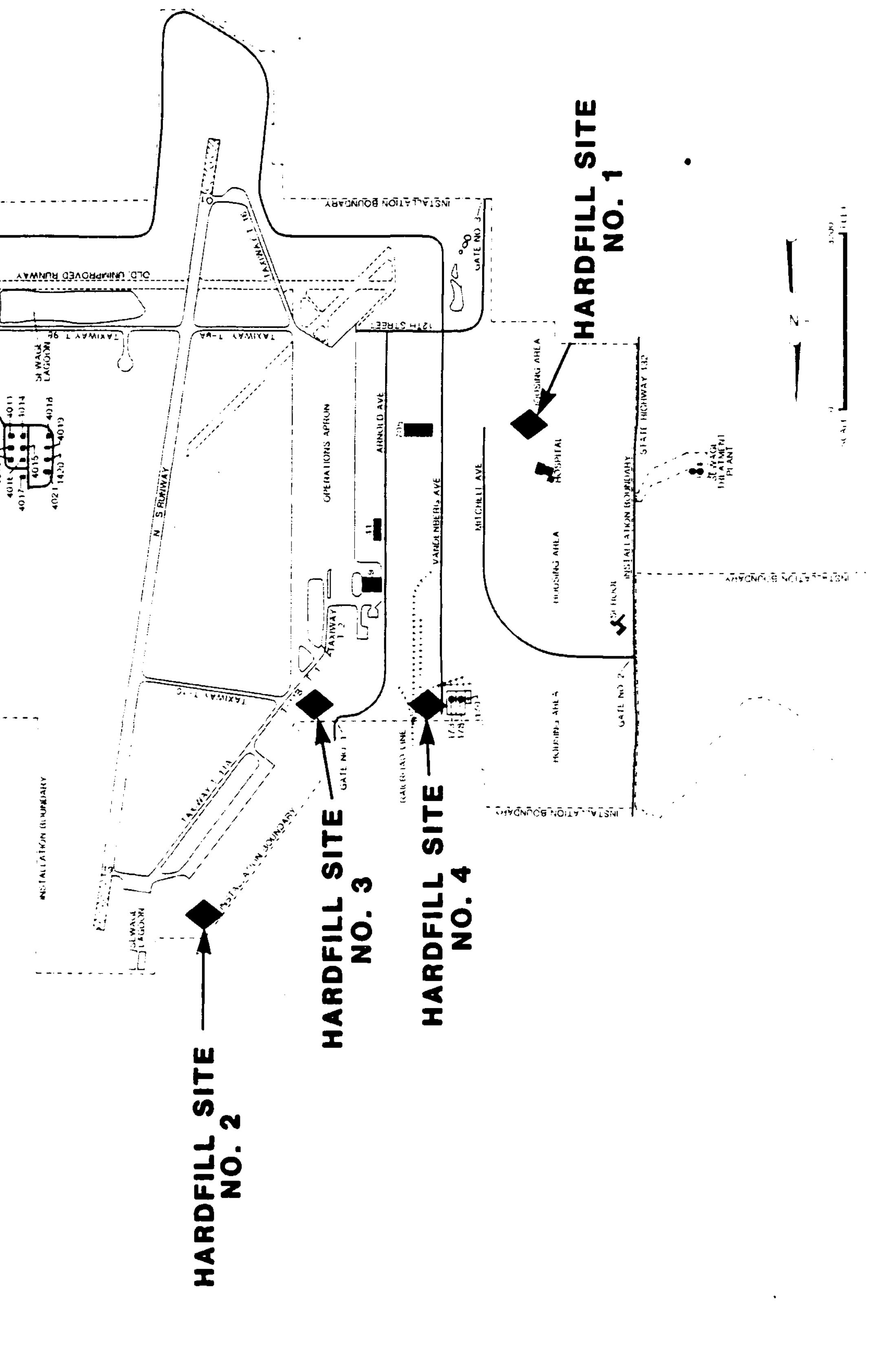
Hardfill Site No. 2

Hardfill Site No. 2 is located at the north end of the base, north of the alert apron. This site, consisting of approximately 500 square yards of ground area, contains construction hardfill and brush. No visual evidence of contamination from this site was noted. The site is presently used for brush disposal.

Hardfill Site No. 3

Hardfill Site No. 3 is located at the north end of the base, east of Gate No. 1. The site occupies approximately 500 square yards of ground area, and contains construction rubble and brush. No visual evidence of contamination at the site was noted. The site is presently used for brush disposal.

WHITEMAN AFB
HARDFILL SITES



SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS

Hardfill Site No. 4

Hardfill Site No. 4, located east of the POL tank area, is the largest and most active of the hardfill sites. The site is estimated tooccupy about 1,000 square yards of surface area, and is currently used for rubble disposal. No visual evidence of contamination from the site was noted.

Surface Impoundments

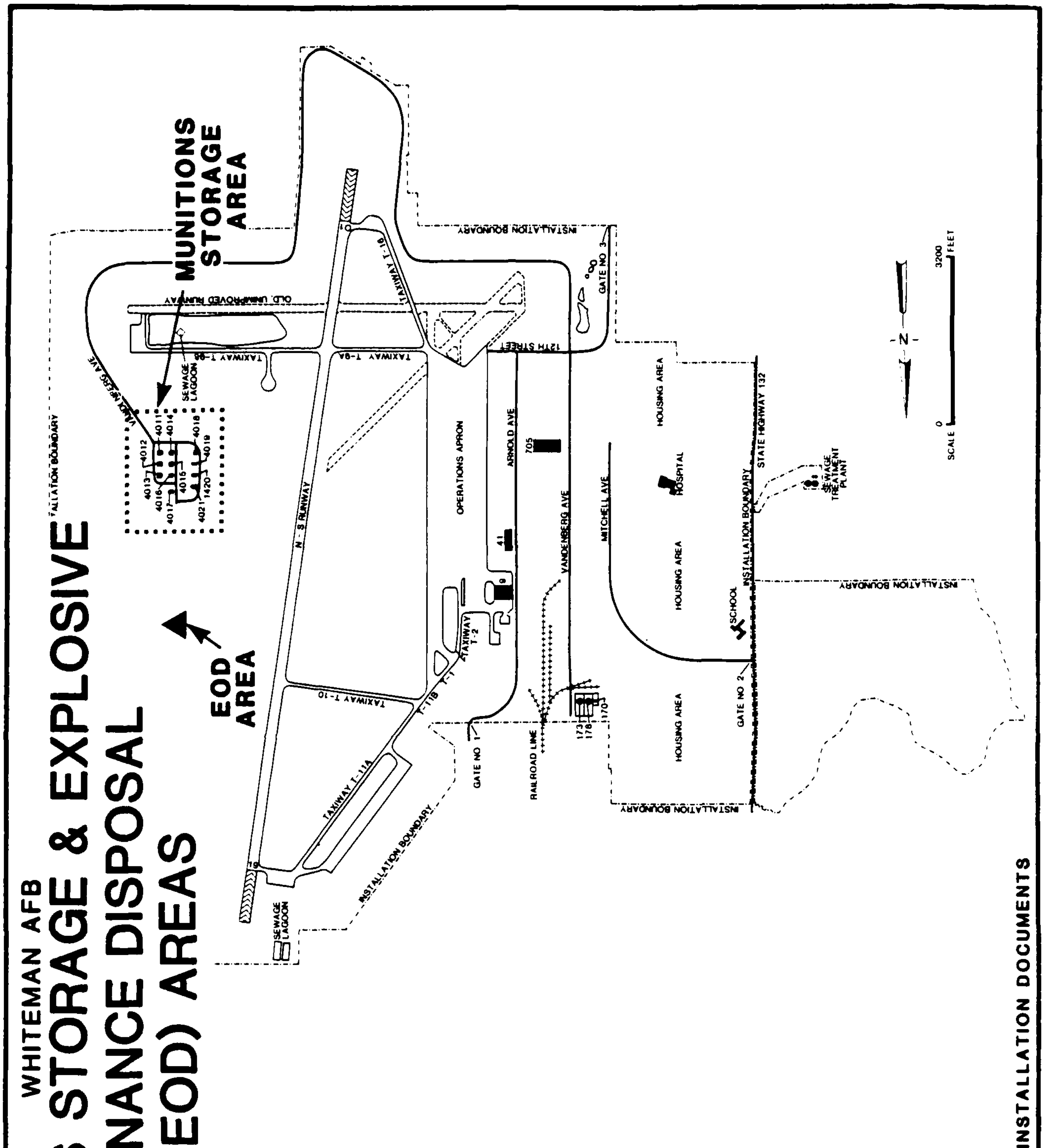
Surface impoundments on Whiteman AFB consist of a series of five ponds located at the southwest corner of the base near the picnic area west of Vandenberg Avenue. These ponds are supplied by surface drainage from the area. No past environmental contamination was reported to be associated with these ponds, and a visual inspection during the site visit showed no evidence of present or past contamination.

Two ponds are present on the base golf course, on land leased from Knob Noster State Park. No environmental contamination is associated with these ponds.

Explosive Ordnance Disposal Area

The explosive ordnance disposal (EOD) area on Whiteman AFB is located approximately 1,500 feet north of the munitions storage area as shown in Figure 4.8. The EOD area consists of a depressed area for detonation of active explosives and a "burn kettle" for incineration of expended small arms ammunition. Typically a quantity of explosives not exceeding 20 pounds (or 36 pounds upon approval) may be disposed of on a monthly basis at the site. The detonation remains are disposed of in the depressed area at the center of the EOD area. Expended small arms ammunition is disposed of by burning in a metal "kettle" in the EOD area. Diesel fuel is used to ignite the materials. The remains after burning are inspected to allow removal of any unburned ammunition and the burned portion is disposed of in a pit at the site. The pit is approximately 10 feet by 20 feet in area, and is about six feet deep. The pit often contains water from surface runoff.

A grenade test and training range is located approximately 1,000 feet north of the main EOD area. In this area, training grenades are used two to three times per month in personnel training exercises. The training grenades are not high explosive devices; they break open upon



WHITEMAN AFB
MUNITIONS STORAGE & EXPLOSIVE ORDNANCE DISPOSAL (EOD) AREAS

SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS

impact to release a white fluorescent marker gas. Empty and faulty (unopened) training grenades are not retrieved from the area.

Low-level Radioactive Waste Burial Sites

Two low-level radioactive waste disposal sites exist on Whiteman Air Force Base as shown in Figure 4.9. The first site (Site No. 1), is located west of North Barksdale Road within the present housing area. A quantity of electron tubes and various radio components was buried at this site in the early to mid-1950s. In 1957, the material was relocated to Site No. 2, to remove the material from the region of new base housing. The material was contained in metal containers, filled with concrete, ranging in size from about five gallons to about 100 gallons. Approximately 100 tubes were transferred to Site No. 2. Site No. 2 occupies approximately 400 square feet of marked surface area; the site is presently covered with a grassy undergrowth. The burial depth of the radioactive materials is estimated to be about six feet. The site is fenced and posted with warning signs.

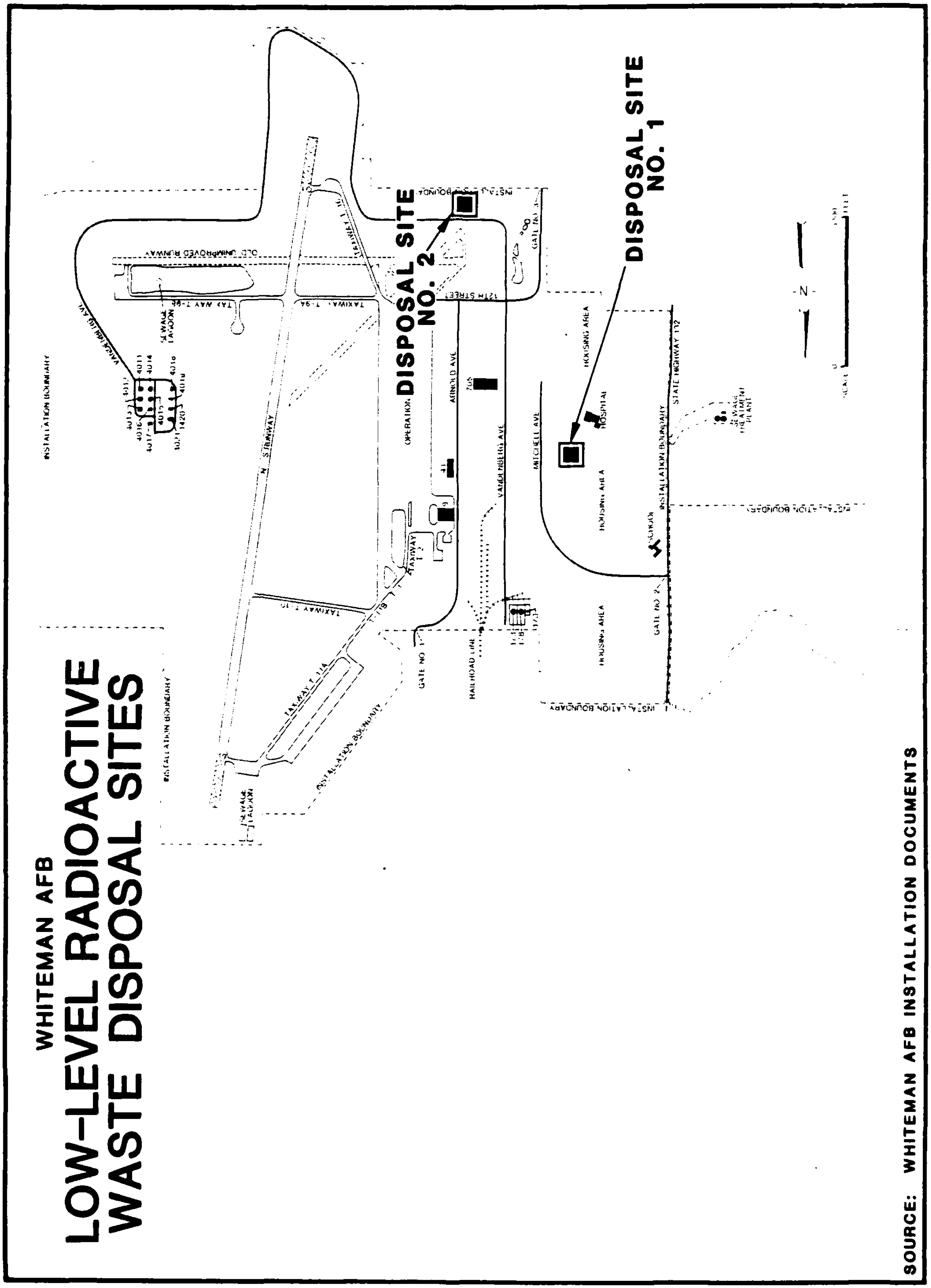
Some question remains as to whether all the material originally buried at Site No. 1 was relocated to Site No. 2. A discrepancy exists between the complete inventory of the transferred material and the inventory of materials originally buried at Site No. 1. After the relocation, a radiation detection device was used to survey the surface of Site No. 1; only background levels were registered.

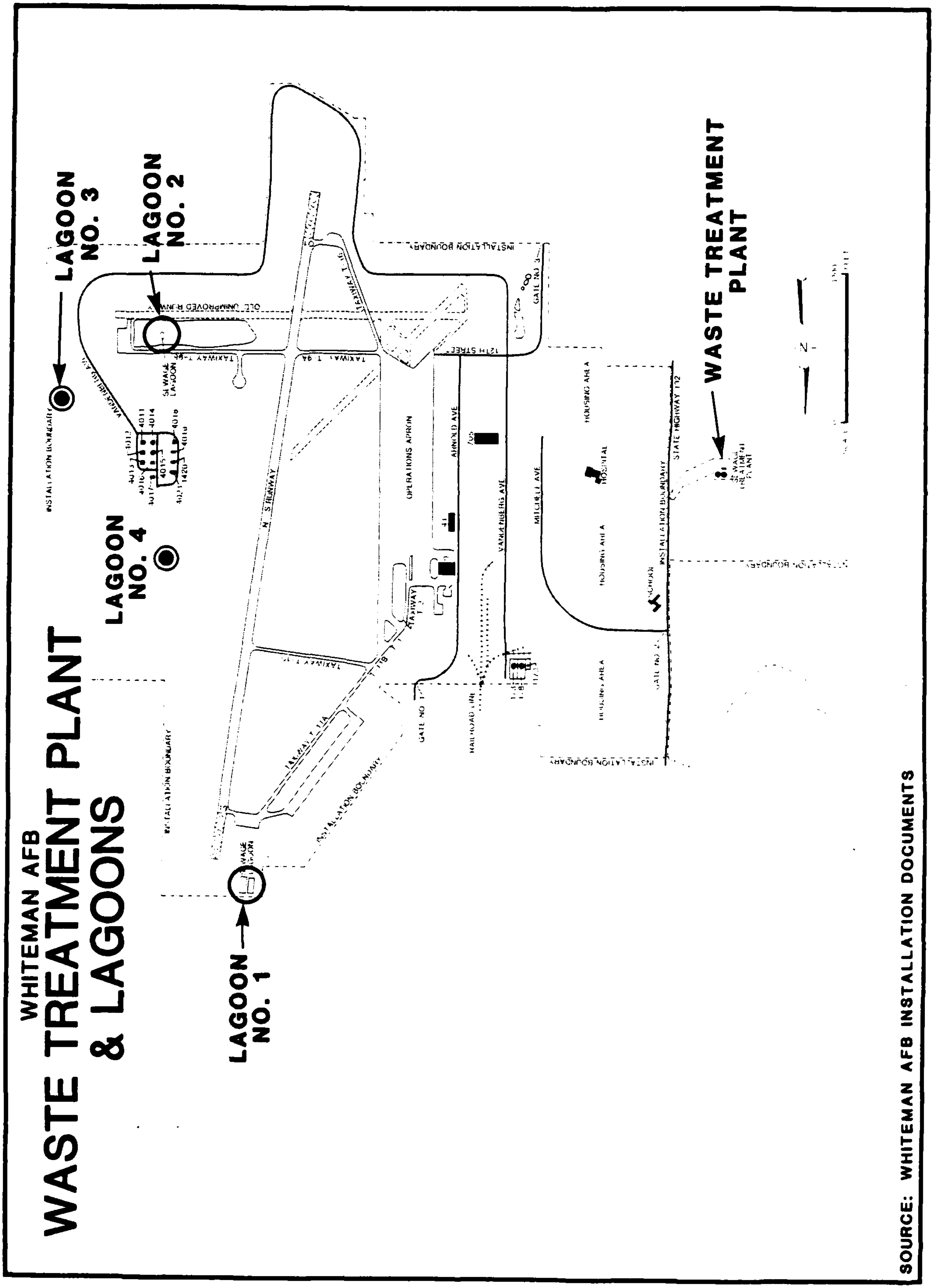
Incinerators

Incineration has been used at Whiteman AFB for disposal of two types of waste materials. First, pathological wastes (about two pounds per day average) from Whiteman AFB Hospital are burned in a multichamber incinerator at the hospital. This incinerator uses Number 2 diesel fuel as the auxiliary fuel at the rate of approximately 200 gallons per year. Ash from the incinerator is disposed of with base refuse. Secondly, classified documents, other paper, and some plastics are burned in a multi-chamber incinerator at Building 1426. The auxiliary fuel for this incinerator is natural gas; ash is disposed of with base refuse.

Sanitary Wastewater Treatment System

Sanitary wastewater treatment on Whiteman AFB is performed by the sanitary wastewater treatment plant located south of the golf course and across State Highway 132 from the main base property (see Figure 4.10).


WHITEMAN AFB
LOW-LEVEL RADIOACTIVE
WASTE DISPOSAL SITES
DISPOSAL SITE
NO. 1
DISPOSAL SITE
NO. 2
INSTALLATION BOUNDARY
OLD UNIMPROVED RUNWAY
12TH STREET
ARNOLD AVE
VANDENBERG AVE
MITCHELL AVE
HOUSING AREA
HOSPITAL
STATE HIGHWAY 132
SEWAGE TREATMENT PLANT
GATE NO 1
GATE NO 2
RAILROAD LINE
SEWAGE LAGOON
OPERATIONS
-N-
SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS



SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS

Sanitary wastewater as well as aqueous effluents from several oil-water separators on the base flow by underground piping to the facility. The plant consists of a primary settling basin, trickling filter, aeration pond, clarifier, and discharge station to Brewer Branch. The plant treats an average of 0.6 MGD of flow. Sludge from the treatment process is digested and spread on drying beds, from there it is transported to an area of the golf course for composting and used as fill material. The sludge has not been analyzed to determine its characteristics, but it has been assumed to be non-hazardous by base personnel because of the nonhazardous nature of the wastes treated by the plant.

While the sanitary sewer system and the waste treatment plant serve the vast majority of base facilities, there are three areas which are served by sewage lagoons. These are the Alert Facility (Building 6), Building 3300, and the dog kennels (see Figure 4.10). These sewage lagoons do not treat hazardous wastes.

The Alert Facility, Building 6, is served by twin lagoons northeast of the building near the base perimeter. These lagoons are of earthen construction, are not aerated, and do not discharge to a waterway. Apparently evaporation and infiltration have prevented overfilling of the lagoons.

Building 3300, located near the southeast end of the base at the transient missile holding facility, is served by a small earthen lagoon installed in 1964 northwest of the building. The lagoon is about 500 square yards in surface area, and is fenced. The lagoon is not aerated and does not discharge to a waterway.

The dog kennels, located in Building 3999, are served by a lagoon which was installed in 1972 to replace a septic tank at the site. The lagoon was constructed to store and treat the aqueous washdown from kennels for up to 20 dogs, although only six are housed at the facility at present. The lagoon is not aerated, is of earthen construction, and does not discharge to a waterway.

Storm Water Drainage System

The storm drainage system on Whiteman AFB consists of open ditches, concrete-lined ditches, and underground storm drainage lines. Three major underground mains drain the eastern section of the base. These drainage mains range in diameter from 24 to 144 inches. One major above-ground feature in the southern section of the base is the large diameter drainage alignment permitting the passage of Long Branch Creek below Vandenburg Avenue and the runway.

Five small impoundments located in the southwest corner of the base are utilized to control flow and sedimentation.

Oil-Water Separators

There are eight oil-water separators of significant size at Whiteman AFB. One separator is not presently in use. There are several small (10 gallon estimated) in-line separators in floor drains at several buildings. A summary of the information on oil-water separators at the base is presented in Table 4.4. In general the oil layers are removed directly from the separators by an off-base contractor or are stored in drums or tanks for off-base contractor removal. In one case (the two separators at the fire protection training area) the fuel layer is recovered and stored in the waste fuel storage tank for reuse in fire training exercises. In the case of the separator for the hazardous waste storage facility, any oil layers are handled as appropriate to the spill which generates the layer. Water layers from the separators are disposed of by three techniques -- sanitary sewers, storm drains, and drainage ditches, as described in Table 4.4.

Excess Pesticide Disposal Area

Excess prepared pesticide left over at the end of a workday, is applied to the gravelled ground within the POL diked areas. Access to this area is limited and no signs of environmental stress were observed during the site visit.

Sodium Chromate Treatment Areas

Each launch facility for the Minuteman II ICBM system contains a sodium chromate coolant loop which serves the missile guidance system. The sodium chromate at each site is routinely replaced (1.5 gallons per site) and the waste chromate is removed and returned to the base for disposal. Disposal at present is under DPDO contract; however, in the past a three-step system was used to reduce the chromate to a less toxic form (Cr^{+3}) for disposal. This chromate reduction system was initiated at Building T-8, where it operated from the mid-1960s until 1981, when the process was moved to the waste treatment plant. The reduction process was discontinued in 1982, when DPDO disposal of the untreated

TABLE 4.4

OIL-WATER SEPARATORS, WHITEMAN AIR FORCE BASE

Location	Service	Volume (Gallons)	Oil Layer Fate	Aqueous Layer Fate
Building 121	Fuel truck maintenance area.	260	Waste oil tanks for contractor removal.	Storm drain.
Building 159	Vehicle Maintenance.	600	Contractor disposal.[2]	Sanitary sewer (1980-present). Drainage ditch to creek (before 1980).
Building 52	Air National Guard Maintenance hangar.	1,000	Contractor disposal.	Sanitary sewer.
Building 650	Auto hobby shop.	1,000	Contractor disposal.	Sanitary sewer.
Building 8[1]	Aircraft wash rack.	400	--	Storm drain.
Building 128	Hazardous waste storage yard.	1,000	Specific to waste.	Contractor disposal.[3]
FPTA	Fire training area (two separators).		Waste fuel storage for reburn.	Drainage ditch to creek.
Bldgs. 4, 9, 41, 43, 49	Floor drain separators.	10 (est.)	Drums at site for contractor disposal.	Storm drain.

[1] Not in use (1983).

[2] Contractor disposal refers to contractor pump-out of the oil layer directly from the separator.

[3] All spills are contained and removed prior to entering the oil-water separator.

waste chromate was begun. During the reduction process spills occurred onto the floor of Building T-8 and the ground at the waste treatment plant; these spills were reported to be small (two gallons or less) and no large volume spill episode was reported.

EVALUATION OF PAST DISPOSAL ACTIVITIES AND FACILITIES

None of the remote base communications annexes was found to have significant waste generation or disposal activities, past or present.

The review of past operation and maintenance functions and past waste management practices at Whiteman AFB has resulted in the identification of 40 sites which were initially considered as areas of concern with regard to the potential for contamination, as well as the potential for the migration of contaminants. These sites were evaluated using the Decision Tree Methodology referred to in Figure 1.1. Those sites which were considered as not having a potential for contamination were deleted from further consideration. Those sites which were considered as having a potential for the occurrence of contamination and migration of contaminants were further evaluated using the Hazard Assessment Rating Methodology (HARM). Table 4.5 identifies the decision tree logic used for each of the areas of initial concern.

Based on the decision tree logic, 27 of the 40 sites originally reviewed did not warrant evaluation using the Hazard Assessment Rating Methodology. The rationale for omitting these 27 sites from HARM evaluation is discussed below.

The storage sites eliminated by the decision tree logic show minimal potential for environmental contamination or contaminant migration, as supported by the absence of significant past spills associated with these locations.

The two areas in which aircraft had burned were concrete operations apron areas, and the unburned fuels released from the burning aircraft were discharged to drainage ditches near the operations apron. The fuels were transported to storm sewer discharges, and a negligible potential for environmental contamination remains.

The Launch Control Facilities (LCF's) and Launch Facilities (LF's) associated with the 351st Strategic Missile Wing are considered to have negligible potential for contaminant migration. The lagoons at the LCF

TABLE 4.5

SUMMARY OF DECISION TREE LOGIC FOR AREAS OF INITIAL ENVIRONMENTAL CONCERN AT WHITEMAN AFB

Site	Potential for Contamination	Potential for Contaminant Migration	Potential for Other Environmental Concern	HARM Rating
Fire Protection Training Area	Y	Y	N/A	Y
Waste Storage Site (Bldg. 8)	Y	N	N	N
Waste and/or Material Storage Site (Hangar 4)	Y	N	N	N
Waste and/or Material Storage Site (Bldg. T-9)	Y	Y	N/A	Y
Waste and/or Material Storage Site (Bldg. 16)	Y	N	N	N
Waste and/or Material Storage Site (Bldg. 52)	Y	N	N	N
Waste and/or Material Storage Site (Bldg. 159)	Y	N	N	N
Waste and/or Material Storage Site (Bldg. 44)	Y	N	N	N
Waste and/or Material Storage Site (Bldg. 166, outside)	Y	N	N	N
Waste and/or Material Storage Site (Facility 128)	Y	N	N	N
Waste and/or Material Storage Site (Bldg. 166, inside)	Y	N	N	N
Waste and/or Material Storage Site (Bldg. 2003)	Y Y	N N	N N	N N
Waste and/or Material Storage Site (Bldg. 707)	Y	N	N	N
Storm Drainage at Aircraft Wash Rack	Y	Y	N/A	Y
B-47 Burn Area	N	N	N	N
F-104 Burn Area	N	N	N	N
Launch Control Facilities (LCFs)	Y	N	N/A	N
Launch Facilities (LFs)	Y	N	N/A	N

Y - Yes N - No N/A - Not applicable

TABLE 4.5
(Continued)
SUMMARY OF DECISION TREE LOGIC FOR AREAS OF INITIAL ENVIRONMENTAL CONCERN AT WHITEMAN AFB

Site	Potential for Contamination	Potential for Contaminant Migration	Potential for Other Environmental Concern	HARM Rating
Landfill No. 1	Y	Y	N/A	Y
Landfill No. 2	Y	Y	N/A	Y
Landfill No. 3	Y	Y	N/A	Y
Landfill No. 4	Y	Y	N/A	Y
Landfill No. 5	Y	Y	N/A	Y
Hardfill Area No. 1	N	N	N	N
Hardfill Area No. 2	N	N	N	N
Hardfill Area No. 3	N	N	N	N
Hardfill Area No. 4	N	N	N	N
Surface Impoundments	N	N	N	N
Explosive Ordnance Disposal Area	Y	N	N/A	N
Low-Level Radioactive Waste Burial Site 1	Y	Y	N/A	Y
Low-Level Radioactive Waste Burial Site 2	Y	Y	N/A	Y
Incinerators	N	N	N	N
Wastewater Treatment Plant	N	N	N	N
Sewage Lagoons - Bldg. 6	N	N	N	N
Sewage Lagoon - Bldg. 3300	N	N	N	N
Sewage Lagoon - Bldg. 3999	N	N	N	N
Excess Pesticide Disposal Area	Y	Y	N/A	Y
Sodium Chromate Treatment Area at Waste Treatment Plant	Y	Y	N/A	Y
Chlordane Application Areas	Y	Y	N/A	Y

Y - Yes N - No N/A - Not applicable

sites are well-maintained and treat primarily sanitary sewage, with only minimal industrial chemical discharge. The LF sites, while not served by lagoons, are covered with a gravel base and routinely have only very minor discharges of contamination from the sump discharges. At no LF or LCF sites was evidence of significant hazardous waste contamination present, and interviews and base records examinations revealed no significant incidents of contaminant migration associated with these facilities.

The hardfill areas were examined for potential disposal of materials other than construction rubble and brush, and no evidence of such disposal was found. Furthermore, interviews and base records searches did not reveal disposal of materials other than rubble and brush. As a result, the hardfill areas are not considered to possess significant potential for environmental contamination.

The surface impoundments on the base are used for storm water flow control, and are not used for storage, treatment, or disposal of any wastes. Consequently, these impoundments are considered to have negligible potential for environmental contamination.

The explosive ordnance disposal area is considered to have negligible potential for environmental contamination because of the disposal methods employed at this site.

Because of the nature of the materials burned in the incinerators and the high temperatures employed in the multiple chamber units, no potential for environmental contamination is associated with the two incinerators.

The wastewater treatment plant on base treats primarily sanitary wastewater. The effluent discharge meets NPDES requirements and the sludge is composted for use on the base. There is low potential for environmental contamination associated with the operation of the wastewater treatment plant.

The remaining thirteen sites identified on Table 4.5 were evaluated using the Hazard Assessment Rating Methodology. The HARM process takes into account characteristics of potential receptors, waste characteristics, pathways for migration, and specific characteristics of the site related to waste management practices. The details of the rating procedures are presented in Appendix G. Results of the assessment for the sites are summarized in Table 4.6. The HARM system is designed to indicate the relative need for follow-on action. The information presented in Table 4.6 is intended for assigning priorities for further evaluation of the Whiteman AFB disposal areas (Section 5, Conclusions and Section 6, Recommendatons). The rating forms for the individual waste disposal sites at Whiteman AFB are presented in Appendix H. Photographs of some of the disposal sites are included in Appendix F.

TABLE 4.6
SUMMARY OF HARM SCORES FOR POTENTIAL
CONTAMINATION SOURCES
WHITEMAN AFB

Rank	Site	Receptor Subscore	Waste Characteristics Subscore	Pathways Subscore	Waste Management Factor	Overall Total Score
1	Chlordane Application Areas	72	54	69	1.00	65
2	Fire Protection Training Area	44	64	80	1.00	63
3	Landfill No. 5	56	72	69	0.95	62
4	Excess Pesticide Disposal Area	57	60	61	1.00	59
5	Sodium Chromate Treatment Area At Waste Treatment Plant	55	60	54	1.00	56
6	Drum Storage Area at Bldg. T-9	37	54	61	1.00	51
7	Storm Water Drainage From Aircraft Wash Rack	52	24	61	1.00	46
8	Landfill No. 1	57	14	61	0.95	42
9	Low-Level Radioactive Waste Disposal Area No. 1	59	10	61	0.95	41
10	Low-Level Radioactive Waste Disposal Area No. 2	44	15	54	0.95	36
11	Landfill No. 2	44	14	54	0.95	35
12	Landfill No. 3	44	9	54	0.95	34
13	Landfill No. 4	44	9	54	0.95	34

SECTION 5
CONCLUSIONS

The goal of the IRP Phase I study is to identify sites having potential for environmental contamination resulting from past waste disposal practices and to assess the probability of contaminant migration from these sites. The conclusions given below are based on field inspections, review of records and files, review of the environmental setting, and interviews with base personnel, past employees, and federal, state, and local government employees. Table 5.1 contains a list of the potential contamination sources identified at Whiteman AFB and a summary of the HARM scores for those sites is summarized below. The follow-on recommendations are presented in Chapter 6.

CHLORDANE APPLICATION AREAS

There is sufficient evidence that the Chlordane Application Areas site has potential for creating environmental contamination and a follow-on investigation is warranted. Since 1980, chlordane has been applied to ground areas adjacent to base housing in several locations for termite control. Concentrations of chlordane above background levels have been detected in surface water discharges from the base.

This site is underlain by silty or loamy soils of the Gorin, Haig and Sampsel types (see Table 3.2). They possess low permeability, are subject to excessive wetness and may provide some recharge to deeper aquifers. This site received a HARM score of 65.

FIRE PROTECTION TRAINING AREA

There is sufficient evidence that the Fire Protection Training Area has potential for creating environmental contamination and a follow-on investigation is warranted. The Fire Protection Training Area has been used during all periods of base activity for its present purpose. At present only contaminated JP-4 is used as the fuel, but in the past,

TABLE 5.1
SITES EVALUATED USING THE
HAZARD ASSESSMENT RATING METHODOLOGY FORMS
WHITEMAN AIR FORCE BASE

Rank	Site	Operating Period	Final HARM Score
1	Chlordane Application Areas	1980 - present	65
2	Fire Protection Training Area	1940's - present	63
3	Landfill No. 5	1972 - 1977	62
4	Excess Pesticide Disposal Area	1950's - present	59
5	Sodium Chromate Treatment Area At Waste Treatment Plant	1980 - 1981	56
6	Drum Storage Area At Bldg. T-9	1960's - present	51
7	Storm Water Drainage From Aircraft Wash Rack	1950's - present	46
8	Landfill No. 1	1940's	42
9	Low-Level Radioactive Waste Disposal Area No. 1	1952 - 1957	41
10	Low-Level Radioactive Waste Disposal Area No. 2	1957 - 1959	36
11	Landfill No. 2	1950's	35
12	Landfill No. 3	late 1940's - mid 1950's	34
13	Landfill No. 4	1957 or 1958	34

waste solvents, hydraulic oils, and other combustible materials were used.

This site is underlain by clayey man-made soils (fill or Haplaquents - urban land) and clayey residuum. It is unlikely that a shallow perennial aquifer is associated with these soils. This site received a HARM score of 63.

LANDFILL NO. 5

There is sufficient evidence that the Landfill No. 5 site has potential for creating environmental contamination and a follow-on investigation is warranted. The landfill site was used from 1972 until 1977 for disposal of general refuse and approximately 30 drums of waste cleaning solvents, fuels, and other materials.

The landfill was closed in 1977, and some of the drums were removed about 1981, but other drums remain buried. Long Branch Creek flows adjacent to the landfill.

The site is located immediately south of Long Branch. The north part of the site was likely constructed in or on stream alluvium (probably lightning silt loam). The south part of the site probably overlies residuum. This material may comprise an ephemeral aquifer and is typically a sandy silty material. It is known to be subject to wetness and flooding (Table 3.2). The connection between the stream and soils underlying the site is unknown. It is suspected that the stream may recharge soils underlying the site during wet seasons and that this situation could reverse during dry seasons. It is not likely that a uniform, isotropic shallow aquifer underlies the entire site which would permit the establishment of a conventional ground-water monitoring program. This site received a HARM score of 62.

EXCESS PESTICIDE DISPOSAL AREA

There is sufficient evidence that the Excess Pesticide Disposal Area has potential for creating environmental contamination and a follow-on investigation is warranted. The pesticide disposal area at the POL tank diked area has been used for the disposal of rinsate and excess pesticide dilutions for a number of years. Surface water quality for several sampling points have shown measurable concentrations of several pesticides. Although it is unclear whether the pesticides measured in the surface water are a result of disposal at this site or a result of other activities, further examination of this site is warranted.

This site is underlain by clayey man-made soils (fill or Haplaquents - urban land) and residuum. It is uncertain if the site is underlain by a shallow perennial aquifer present in these soils. This site received a HARM score of 59.

SODIUM CHROMATE TREATMENT AREA AT WASTE TREATMENT PLANT

There is sufficient evidence that the Sodium Chromate Treatment Area at Waste Treatment Plant site has potential for creating environmental contamination and a follow-on investigation is warranted. The site at the waste treatment plant was used in the early 1980's for reduction of chromium from the missile guidance system coolant waste. Spills of several gallons or less of the liquid occurred onto the ground on occasion.

This site may be underlain by the Freeburg silt loam, an alluvial material likely deposited by nearby Brewer Branch. The Freeburg is known to be susceptible to seasonal wetness (Table 3.2). It is not known if this unit is associated with a perennial shallow aquifer. This site received a HARM score of 56.

DRUM STORAGE AREA AT BUILDING T-9

There is sufficient evidence that the Drum Storage Area at Building T-9 site has potential for creating environmental contamination and a follow-on investigation is warranted. Since the 1960's, this site has been used for drum storage for waste oils and hydraulic fluid, and numerous spills and leaks have occurred during its period of operation. A storm drainage channel is nearby, so a potential for contaminant migration exists.

This site is underlain by clayey man-made soils (fill or Haplaquents - urban land) and clayey residuum. It is unlikely that a shallow perennial aquifer is associated with these soils. The site received a HARM score of 51.

STORM WATER DRAINAGE AT AIRCRAFT WASH RACK

There is not sufficient evidence that the Storm Water Drainage at Aircraft Wash Rack site has potential for creating environmental contamination and a follow-on investigation is not warranted. The aircraft wash rack was used for cleaning and stripping B-47 aircraft during the 1950's and 1960's, and water-soluble PD-680 entered the storm drainage system at the wash rack. The site is used infrequently for helicopter and vehicle cleaning at present. Drainage from the wash rack entered the storm drainage system after passing through an oil-water separator. This site received a HARM score of 46.

LANDFILL NO. 1

There is not sufficient evidence that the Landfill No. 1 site has potential for creating environmental contamination and a follow-on investigation is not warranted. This site was used for the disposal of general base refuse; there is no evidence of hazardous waste disposal at this site. The site received a HARM score of 42.

LOW-LEVEL RADIOACTIVE WASTE DISPOSAL AREA NO. 1

There is not sufficient evidence that the Low-Level Radioactive Waste Disposal Area No. 1 site has potential for creating environmental contamination and a follow-on investigation is not warranted. This site was used for disposal of low-level radioactive tubes and other low-level materials until 1957, when the contents were relocated to Site No. 2. Although there was an inventory discrepancy between the materials deposited and those removed, a radiation detection device did not detect radiation levels greater than background at the site after the relocation. The site received a HARM score of 41.

LOW-LEVEL RADIOACTIVE DISPOSAL AREA NO. 2

There is not sufficient evidence that the closed Low-Level Radioactive Disposal Area No. 2 site has potential for creating environmental contamiation and a follow-on investigation is not warranted. The materials removed from Site No. 1 were placed at Site No. 2, which is fenced and posted with warning signs.

This site is underlain by man-made soils (fill or Haplaquents - urban land) and clayey residuum. It is unlikely that a shallow perennial aquifer is associated with these soils. The site received a HARM score of 36.

LANDFILL NO. 2

There is not sufficient evidence that the Landfill No. 2 site has potential for creating environmental contamination and a follow-on investigation is not warranted. This site was used for the disposal of general base refuse; there is no evidence of hazardous waste disposal at this site. The site received a HARM score of 35.

LANDFILL NO. 3

There is not sufficient evidence that the Landfill No. 3 site has potential for creating environmental contamination and a follow-on investigation is not warranted. This site was used for the disposal of general base refuse; there is no evidence of hazardous waste disposal at this site. The site received a HARM score of 34.

LANDFILL NO. 4

There is not sufficient evidence that the Landfill No. 4 site has potential for creating environmental contamination and a follow-on investigation is not warranted. This site was used for the disposal of general base refuse; there is no evidence of hazardous waste disposal at this site. The site received a HARM score of 34.

SECTION 6

RECOMMENDATIONS

Six sites were identified at Whiteman AFB as having the potential for environmental contamination. These sites have been evaluated using the HARM system which assesses their relative potential for contamination and provides the basis for determining the need for additional Phase II, IRP investigation. All of the sites have sufficient potential to create environmental contamination and Phase II investigations are recommended. All sites have been reviewed with regard to land use restrictions which may be applicable.

PHASE II MONITORING

The subsequent recommendations are made to further assess the potential for environmental contamination from waste disposal areas at Whiteman AFB. The recommended actions are generally one-time sampling programs to determine if contamination does exist at the site. If contamination is identified, the sampling program may need to be expanded to define the extent of contamination. The recommended monitoring program, including analytical parameters, is summarized in Table 6.1. The proposed parameter lists are based upon consideration of the identity of the potential contaminants. Figure 6.1 illustrates several proposed Phase II monitoring locations. Precise boring locations are to be determined at the initiation of Phase II activities. The proposed sampling locations are based upon consideration of local soil and surface water conditions. Water samples should be taken during low-flow periods. Environmental sampling may consist of the following procedures:

1. Stream (grab) sampling at strategically selected locations and analysis for certain indicator parameters.

TABLE 6.1
RECOMMENDED MONITORING PROGRAM FOR PHASE II
IRP AT WHITEMAN AFB

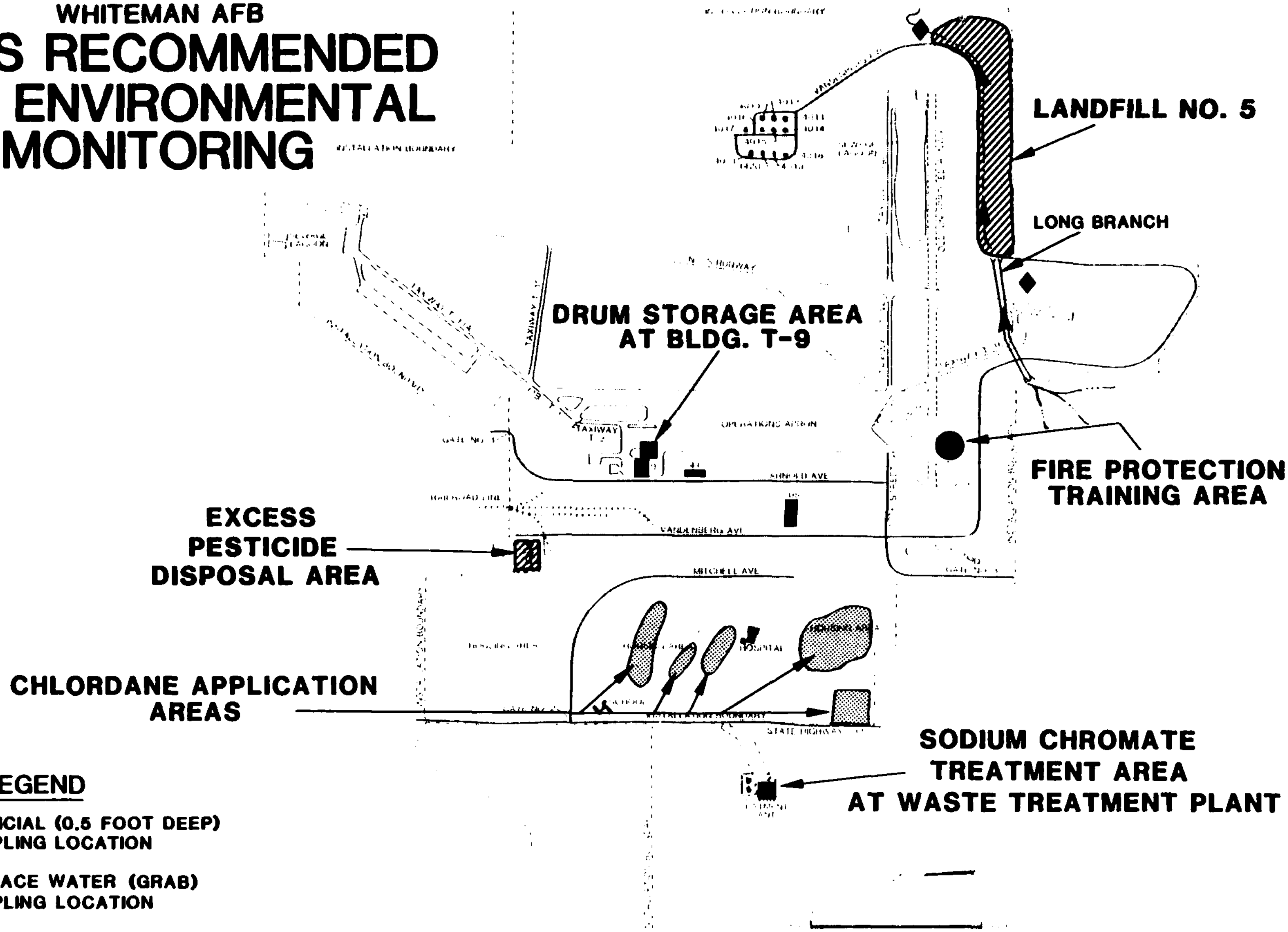
Area/Site (Rating Score)	Recommended Monitoring(1)	Recommended Analytical Parameters
Chlordane Application Areas (65)	Drill borings 5 feet deep at selected locations. Sample at one foot intervals.	pH Chlordane
Fire Protection Training Area (63)	Drill borings 5 feet deep at four locations around site. Sample at one foot intervals.	pH Total dissolved solids Oil and grease Total organic carbon Total organic halogens Phenols Chromium Lead
Landfill No. 5 (62)	Sample stream water (Long Branch) at two locations. Sample sediments.	pH Total dissolved solids Oil and grease Total organic carbon Total organic halogens Phenols Chromium (VI) Lead
Excess Pesticide Disposal Area (59)	Drill borings 5 feet deep at three locations around site. Sample at one foot intervals.	pH Total dissolved solids Total organic halogens Phenols Pesticides
Sodium Chromate Treatment Area at Waste Treatment Plant (56)	Perform surficial soil sampling at four locations around site.	pH Total dissolved solids Chromium
Drum Storage Area at Bldg. T-9 (51)	Drill borings 5 feet deep at three locations around site. Sample at one foot intervals. Obtain grab sample from nearby storm drain.	pH Total dissolved solids Oil and grease Total organic carbon Total organic halogens Phenols Chromium (VI) Lead

(1) See Figure 6.1 for sampling locations.

FIGURE 6.1

WHITEMAN AFB

SITES RECOMMENDED FOR ENVIRONMENTAL MONITORING



LEGEND

■ SURFICIAL (0.5 FOOT DEEP) SAMPLING LOCATION

◆ SURFACE WATER (GRAB) SAMPLING LOCATION

SOURCE: WHITEMAN AFB INSTALLATION DOCUMENTS

2. Surficial soil sampling (no deeper than six inches below surface) and analysis for certain indicator parameters.
3. Shallow soil boring (five feet deep), sampling at one foot intervals (five samples per boring) and analysis for selected indicator parameters.

Geophysical techniques have not been recommended for use at this installation for several reasons including the high clay content of surficial soils and the proximity of some sites to area surface waters (F-5 borders on Long Branch; the WTP borders Brewer Branch). Clay soils tend to degrade the performance of geophysical instruments, while the proximity to other sites and the streams could make data interpretation questionable.

The recommended environmental monitoring programs for those sites receiving comparatively high HARM scores follows:

Chlordane Application Areas

The chlordane application was centered in housing and light industrial areas essentially underlain by silty or loamy soils possessing low permeabilities. Although the areas may be underlain by ephemeral shallow aquifer(s), it is not believed that a conventional ground-water quality monitoring system can be established which will yield dependable, representative samples. This is because the soils may only contain water seasonally and in some areas, not at all. Therefore, soil sampling is recommended. At this time, it is recommended that some fifty (50) five-foot deep test borings be advanced in suspected contaminant areas, sampling at one-foot depth intervals. Soil "blank" samples should be obtained for comparison purposes from selected borings drilled in "clean" areas. A total of five soil samples should be collected from each boring. Samples should be subjected to the E.P. toxicity test; the extract should be tested for the parameters listed in Table 6.1.

Fire Protection Training Area

In order to determine if FPTA - related contamination exists at the site, four (4) borings should be drilled in areas of suspected contamination using a hollow stem auger or similar process. In addition, one boring should be drilled outside the area of suspected contamination to serve as a blank. Sampling of soil materials (probably a man-made fill or disturbed clayey residuum) should commence at ground surface and be performed at one-foot intervals, so that a maximum of five (5) samples is collected at each boring location. Soil samples should be extracted with water according to the E.P. toxicity extraction procedure, and the water extract should be analyzed for the selected indicator parameters listed in Table 6.1. Ground-water monitoring is not recommended at this time due to the probable absence of a shallow aquifer system permitting conventional subsurface monitoring schemes. The clayey soils present in the vicinity of this site may preclude the infiltration of contaminants into deeper water-bearing zones.

Landfill No. 5

Landfill No. 5 is located immediately adjacent to Long Branch, which traverses the south portion of the base. The site is probably underlain by alluvium (silty, sandy material with some clay) in that portion of the landfill near the stream. The section of landfill most distant from the stream could be underlain by clayey residuum. It is unlikely that a uniform shallow aquifer underlies the site. The geologic setting of the site does not appear to favor a conventional ground-water monitoring scheme. The site's proximity to Long Branch and its apparent low surface elevation to the stream suggest that the stream may be both the landfill's primary source of water (with which, leachate is generated) and the primary environmental receptor of waste-related contamination. During wet season stream high-flows, a good portion of the landfill's lower extent probably is inundated. Therefore it is recommended that stream (grab) sampling be conducted at the locations shown on Figure 6.1. Samples should be analyzed for the indicator parameters listed on Table 6.1.

Excess Pesticide Disposal Area

This site is located in a relatively level area and is likely underlain by clayey residuum. In order to determine if environmental contamination has occurred because of past disposal practices, test boring, sampling, and analysis are recommended. Three (3) shallow (five foot deep) test borings should be advanced in areas of suspected contamination and one blank should be taken outside the area. Sampling should commence at ground surface and be performed at one foot intervals so that a maximum of five samples is collected at each boring location.

The soil samples should be extracted with water according to the E.P. toxicity extraction procedure, and the water extracts should be analyzed for the indicator parameters listed in Table 6.1.

Sodium Chromate Treatment Area At Waste Treatment Plant

Although this site could be located in an area where subsurface contaminant migration is possible, the very small quantities of materials lost suggest that a modest environmental monitoring program should be sufficient. Therefore, it is recommended that surficial (surface to a maximum depth of six inches) soil sampling be performed at four (4) locations within the area of suspected contamination and a blank be taken outside the area. Each soil sample should be extracted with water by the E.P. toxicity extraction procedure and the water extracts should be analyzed for the parameters listed in Table 6.1.

Drum Storage Area at Building T-9

Building T-9 is situated in a developed area of the base and is underlain by essentially clayey soils possessing low permeabilities. It is unlikely that a uniform shallow aquifer is present in the area. In order to determine if contaminant migration has occurred, test boring, soil sampling, water sampling and analyses are recommended. Three (3) shallow (five-foot deep) test borings should be advanced in areas of suspected contamination and one (1) blank sample should be obtained outside of the area of interest. Soil sampling should be conducted at one-foot depth intervals, so that a total of five samples are obtained per boring. The soil samples should be analyzed in accordance with the E.P. toxicity test and the extracts tested for the parameters listed in Table 6.1. In addition, a one-time grab (water) sample should be obtained from the nearby storm drain. The grab sample should be analyzed for the parameters listed in Table 6.1.

RECOMMENDED GUIDELINES FOR LAND USE RESTRICTIONS

It is desirable to have land use restrictions for the identified sites to (1) provide continued protection of human health, welfare and the environment, (2) insure that migration of potential contaminants is not promoted through improper land uses, (3) facilitate compatible development of future USAF facilities and (4) allow identification of property which may be proposed for excess or outlease.

The recommended guidelines for land use restrictions at each identified disposal site at Whiteman AFB are presented in Table 6.2. A description of the land use restriction guidelines is included in Table 6.3. Land use restrictions at sites recommended for on-site monitoring should be reevaluated upon completion of the Phase II program and appropriate changes made.

TABLE 6.2
RECOMMENDED GUIDELINES AT POTENTIAL CONTAMINATION SITES FOR LAND USE RESTRICTIONS
WHITEMAN AFB

Site	Recommended Guidelines for Future Land Use Restrictions[1]											
	Construction on the site	Excavation	Well construction on or near the site	Agricultural use	Silvicultural use	Water infiltration (Run-on, ponding, irrigation)	Recreational use	Burning or ignition source	Disposal operations	Vehicular traffic	Material storage	Housing on or near the site
Chlordane Application Areas	NR	NR	R	R	NR	R	NR	NR	NR	NR	R	NR
Fire Protection Training Area	NR	NR	R	NR	R	R	NR	NR	R[2]	NR	NR[3]	R
Landfill No. 5	R	R	R	R	R	R	R	R	R[2]	NR	NR[3]	R
Excess Pesticide Disposal Area	R	R	R	NR	R	R	NR	NR	R[2]	NR	NR[3]	R
Sodium Chromate Treatment Area at Waste Treatment Plant	R	R	R	NR	R	R	NR	NR	R[2]	NR	NR[3]	R
Drum Storage Area at Bldg. T-9	R	R	R	R	NR	R	R	NR	R[2]	NR	NR[3]	R

(1)See Table 6.3 for description of guidelines.
Note the following symbols in this table:
R = Restrict the use of the site for this purpose
NR = No restriction of the site for this purpose

(2)Restrict for all wastes except for construction/demolition debris.

(3)No restriction on solid materials but liquids undesirable.

Source: Engineering-Science

TABLE 6.3
DESCRIPTION OF GUIDELINES FOR LAND USE RESTRICTIONS

Guideline	Description
Construction on the site	Restrict the construction of structures which make permanent (or semi-permanent) and exclusive use of a portion of the site's surface.
Excavation	Restrict the disturbance of the cover or subsurface materials.
Well construction on or near the site	Restrict the placement of any wells (except for monitoring purposes) on or within a reasonably safe distance of the site. This distance will vary from site to site, based on prevailing soil conditions and ground-water flow.
Agricultural use	Restrict the use of the site for agricultural purposes to prevent food chain contamination.
Silvicultural use	Restrict the use of the site for silvicultural uses (root structures could disturb cover or subsurface materials).
Water infiltration	Restrict water run-on, ponding and/or irrigation of the site. Water infiltration could produce contaminated leachate.
Recreational use	Restrict the use of the site for recreational purposes.
Burning or ignition sources	Restrict any and all unnecessary sources of ignition, due to the possible presence of flammable compounds.
Disposal operations	Restrict the use of the site for waste disposal operations, whether above or below ground.
Vehicular traffic	Restrict the passage of unnecessary vehicular traffic on the site due to the presence of explosive material(s) and/or of an unstable surface.
Material storage	Restrict the storage of any and all liquid or solid materials on the site.
Housing on or near the site	Restrict the use of housing structures on or within a reasonably safe distance of the site.

APPENDICES
TABLE OF CONTENTS

APPENDIX A

BIOGRAPHICAL DATA

- E. H. Snider, Ph.D., P.E. - Project Manager
- J. R. Absalon, C.P.G.
- T. R. Harper
- R. J. Reimer

BIOGRAPHICAL DATA

Eric Heinman Snider

Senior Chemical Engineer

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Education

B.S. in Chemistry (Magna Cum Laude), 1973, Clemson University, Clemson, S.C.
M.S. in Chemical Engineering, 1975, Clemson University, Clemson, S.C.
Ph.D. in Chemical Engineering, 1978, Clemson University, Clemson, S.C.

Professional Affiliations

Registered Professional Engineer (Oklahoma No. 13499, Georgia No. 14228)
American Institute of Chemical Engineers
American Chemical Society
American Society for Engineering Education
Certified Professional Chemist, A.I.C. (1975)

Honorary Affiliations

Sigma Xi
Tau Beta Pi
Phi Kappa Phi
Who's Who in the South and Southwest, 1981
Outstanding Young Men of America, 1983

Experience Record

1971-1975	Texidyne, Inc., Clemson, S.C., Staff Chemist. Responsible for routine and specialized chemical analyses for water, wastewater, solid wastes, and air pollution testing. Experience in gas chromatography, atomic absorption, microbiological testing.
1975-1978	Texidyne, Inc., Clemson, S.C., Part-time Consultant. Responsible for overall management of laboratory facilities and some wastewater engineering studies. Also ran incinerator performance studies.

Eric H. Snider (Continued)

1976-1977 Clemson University, Clemson, S.C., Chief Analyst on airborne fluoride monitoring project in Chemical Engineering Department, performed for Owen-Corning Fiberglas Corp., Toledo, Ohio.

1978-1982 The University of Tulsa, Tulsa, OK., Assistant Professor of Chemical Engineering and Associate Director, University of Tulsa Environmental Protection Projects (UTEPP) Program. Normal teaching duties; research centered on specialized petroleum refinery problems of water and solid wastes and oil-water emulsions. Supervised an industry-sponsored research program in the area of oil-water emulsion breaking technologies.

1982-1983 The University of Tulsa, Tulsa, OK., Associate Professor of Chemical Engineering and Director of UTEPP Program. Normal teaching duties; researched and wrote five monographs on environmental areas; including, incineration, flotation, gravity separation, screening/sedimentation, and equalization.

1983-Date Engineering-Science, Senior Engineer. Responsible for a wide variety of waste treatment, chemical process, resource recovery, energy, incineration and air pollution control activities for industrial, governmental and local municipal clients. Recent activities include incineration evaluation for a toxic chemical disposal facility to be operated by the U.S. Army on Johnston Atoll, investigation of the breaking of oil/water emulsions from an industrial process discharge, analytical verification of oil residues in contaminated ground water at a hazardous waste disposal site and evaluation of alternative treatment technologies for a new pharmaceutical production facility including vapor re-compression evaporation, incineration, biological oxidation and various air pollution control systems. Particularly strong technical areas include waste treatment chemistry, incineration, analytical troubleshooting, R&D and resource recovery technologies including energy recovery.

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Snider, E.H.: "Chemical Engineering Laboratory Courses at The University of Tulsa: Improving the Communication of Technical Results," in Proceedings of the Fifteenth Midwest Section Conference of ASEE, pp. IIB28-IIB35, 1980.

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Manning, F.S., E.H. Snider, and E.L. Thackston: "Screening and Sedimentation," Invited Monograph in Series on Wastewater Treatment Technology, W.W. Eckenfelder and J.W. Patterson, ed., 1981.

Short Courses and Presentations

January 1974	Presentation of paper, "Comparison of Existing Air Pollution Levels with Standards," Third Annual Conference on Textile Wastewater and Air Pollution Control, Hilton Head Island, S.C.
May 1974	Presentation of paper, "Thirty Day Biodegradability of Textile Chemicals and Dyes," 1974 Annual Technical Conference of American Association of Textile Chemists and Colorists, New Orleans, LA.
June 1977	Presentation, "Air Pollution Instrumentation"; Short Course on Industrial Pollution Control, Clemson University, Clemson, S.C.
June 1977	Presentation, "Industrial Sludge Treatment and Disposal"; Short Course on Industrial Pollution Control, Clemson University, Clemson, S.C.
October 1977	Presentation, "A Kinetic Study of the Reactions of Biphenyl and Chlorine in Water to Form Chlorobiphenyls"; Chem. Eng. Dept. seminar, Clemson University, Clemson, S.C.
January 1978	Presentation of paper, "Carbon Adsorption for Removal of Gaseous Pollutants," 1978 Technical Meeting of American Association of Textile Chemists and Colorists, New York, N.Y.
January 1978	Presentation of paper, "Carbon Adsorption for Removal of Gaseous Pollutants," The University of Tulsa, Tulsa, OK.
June 1980	Presentation of paper, "Powdered Activated Carbon Enhancement of the Activated Sludge Process," Eighth Annual Meeting of the Water and Wastewater Treatment Manufacturers Association, Austin, TX.

Eric H. Snider (Continued)

June 1981	Presentation of paper, "The Valve Tray Column: An Experiment in Tray Hydraulics," Annual National Meeting of Am. Soc. for Engr. Education, Los Angeles, CA.
March 1982	Presentation of paper, "PAC Enhancement of the Activated Sludge Process," Chem. Engr. Dept. seminar series, University of Oklahoma, Norman, OK.

Biographical Data

JOHN R. ABSALON
Hydrogeologist

PII Redacted

[redacted]

Education
B.S. in Geology, 1973, Upsala College, East Orange, New Jersey

Professional Affiliations
Certified Professional Geologist (Indiana No. 46)
Association of Engineering Geologists
Geological Society of America
National Water Well Association

Experience Record

1973-1974 Soil Testing Incorporated-Drilling Contractors, Seymour, Connecticut. Geologist. Responsible for the planning and supervision of subsurface investigations supporting geotechnical, ground-water contamination, and mineral exploitation studies in the New England area. Also managed the office staff, drillers, and the maintenance shop.

1974-1975 William F. Loftus and Associates, Englewood Cliffs, New Jersey. Engineering Geologist. Responsible for planning and management of geotechnical investigations in the northeastern U.S. and Illinois. Other duties included formal report preparation.

1975-1978 U.S. Army Environmental Hygiene Agency, Fort McPherson, Georgia. Geologist. Responsible for performance of solid waste disposal facility siting studies, non-complying waste disposal site assessments, and ground-water monitoring programs at military installations in the southeastern U.S., Texas, and Oklahoma. Also responsible for operation and management of the soil mechanics laboratory.

1978-1980 Law Engineering Testing Company, Atlanta, Georgia. Engineering Geologist/Hydrogeologist. Responsible for the project supervision of waste management, water quality assessment, geotechnical, and hydrogeologic studies at commercial, industrial, and government

John R. Absalon (Continued)

facilities. General experience included planning and management of several ground-water monitoring programs, development of remedial action programs, and formulation of waste disposal facility liner system design recommendations. Performed detailed ground-water quality investigations at an Air Force installation in Georgia, a paper mill in southwestern Georgia, and industrial facilities in Tennessee.

1980-Date Engineering-Science. Hydrogeologist. Responsible for supervising efforts in waste management, solid waste disposal, ground-water contamination assessment, leachate generation, and geotechnical and hydrogeologic investigations for clients in the industrial and governmental sectors. Performed geologic investigations at twenty Air Force bases and other industrial sites to evaluate the potential for migration of hazardous materials from past waste disposal practices. Conducted RCRA ground-water monitoring studies for industrial clients and evaluated remedial action alternatives for a county landfill in Florida. Conducted quality management, hydrogeologic and ground-water quality programs for the pulp and paper industry at several mills located in the Southeast United States.

Publications and Presentations

"An Investigation of the Brunswick Formation at Roseland, NJ," 1973, with others, The Bulletin, Vol 18, No. 1, NJ Academy of Science, Trenton, NJ.

"Engineering Geology of Fort Bliss, Texas," 1978, coauthor: R. Barksdale, in Terrain Analysis of Fort Bliss, Texas, US Army Topographic Laboratory, Fort Belvoir, VA.

"Geologic Aspects of Waste Disposal Site Evaluations," 1980, with others, Program and Abstracts AEG-ASCE Symposium on Hazardous Waste Disposal, April 26, Raleigh, NC.

"Practical Aspects of Ground-Water Monitoring at Existing Disposal Sites," 1980, coauthor: R.C. Starr, Proceedings of the EPA National Conference on Management of Uncontrolled Hazardous Sites, HMCRI, Silver Spring, MD.

"Improving the Reliability of Ground-Water Monitoring Systems," 1981, Proceedings of the Madison Conference of Applied Research and Practice on Municipal and Industrial Waste, University of Wisconsin-Extension, Madison, WI.

John R. Absalon (Continued)

Ground-Water Monitoring Workshop, 1982. Presented to Mississippi Bureau of Pollution Control, Jackson, 15-17 February.

Ground-Water Monitoring Workshop, 1982. Presented to Alabama Division of Solid and Hazardous Waste, Huntsville, 20-21 July.

Ground-Water Monitoring Workshop, 1982. Presented to Kentucky Waste Management Division, Bowling Green, 27-28 July.

"Identification and Treatment Alternatives Evaluation for Contaminated Ground Water," 1982, coauthor: M. R. Hockenbury. Presented to Association of Engineering Geologists Symposium on Hazardous Waste Disposal, Atlanta, 17 September.

"Preliminary Assessment of Past Waste Storage and Disposal Sites," 1982, coauthor: W. G. Christopher. Presented to Association of Engineering Geologists Symposium on Hazardous Waste Disposal, Atlanta, 17 September.

"Treatment Alternatives Evaluation for Aquifer Restoration," 1983, coauthor: M. R. Hockenbury, Proceedings of the Third National Symposium on Aquifer Restoration and Ground Water Monitoring, NWWA, Worthington, OH.

Biographical Data

THOMAS R. HARPER
Chemist

PII Redacted

[redacted]

Education

B.S. in Chemistry, 1983, Ohio State University, Columbus, OH
B.S. in Microbiology, 1983, Ohio State University, Columbus, OH

Professional Affiliations

American Chemical Society

Experience Record

Summers 1980-1981	Reliance Electric Company, Stone Mountain, Georgia - Test Technician. Performed quality assurance testing on instrumentation and wiring on control panels. Performed stress and performance testing and some trouble-shooting on programmable controllers.
1983-Date	Engineering-Science, Inc., Atlanta, Georgia - Analytical Chemist. Laboratory activities included analytical work involving samples from industrial/environmental clients. Analyses for priority pollutants, heavy metals, and organic compounds on samples including soils, sludges, water, and wastewater has been done in the laboratory. Analytical instrumentation includes atomic absorption and TOC. Experience includes work with gas and liquid chromatography, infrared and nuclear magnetic resonance spectroscopy. Field work includes sampling of sludges and waste water, assisting staff geologist in aquifer pump testing and geophysical resistivity work in determining possible sources of contamination. Data search and observations for potential environmental problems has also been performed. Typical industrial clients for whom analyses have been performed include: Searle, Merck, U.S. Air Force, General Battery and FMC.

Biographical Data

ROBERT J. REIMER

PII Redacted

Chemical Engineer

[redacted]

Education

B.S. in Chemical Engineering, 1979, University of Notre Dame
B.A. in Art, 1979, University of Notre Dame
M.S. in Chemical Engineering, 1980, University of Notre Dame

Honors

Amoco Company Fellowship for Graduate Studies in Chemical Engineering, University of Notre Dame (1979-1980)

Professional Affiliations

American Institute of Chemical Engineers

Experience Record

1978-1979 PEDCo Environmental, Cincinnati. Engineer's Assistant. Responsible for compilation of data base report reviewing solid waste disposal in the nonferrous smelting industry. Participated in SO_2 scrubber emissions testing program, Columbus, Ohio. Worked on team establishing a computerized reference file on the overall smelting industry. Performed technical editing and report review.

1979-1980 Camargo Associates, Ltd., Cincinnati. Design Engineer and Draftsman. Responsible for HVAC design on numerous projects. Designed fire protection system for an industrial plastics press. Designer on various general plumbing jobs. Prepared EPA air pollution permit applications.

1980-Date Engineering-Science. Chemical Engineer. Responsible for the preparation of environmental reports and permit documents as well as providing general environmental assistance to clients to assure compliance with state and federal regulations.

Robert J. Reimer (Continued)

1980-Date Developed cost estimates for several hazardous waste management facility closures. Prepared several Interim Status Standards Manuals, including Manifest Plans, Waste Analysis Plans, Closure Plans and Contingency/ Emergency Plans. Provided technical assistance in the design of a one-million gallon per year fuel alcohol production facility.

Provided assistance for a water reuse/reduction plan at a major petroleum refinery. Conducted an extensive review of emerging energy technologies for the Department of Energy. Participated in several Installation Restoration Programs for the U. S. Air Force. Assisted in the design of a contaminated ground water air stripping column based on a lab model to be developed. Prepared several delisting petitions for the removal of industrial wastestreams from EPA's hazardous waste list. Assisted in a study of waste oil reuse for the U.S. Army CERL.

APPENDIX B

LIST OF INTERVIEWEES

TABLE B.1

LIST OF INTERVIEWEES

Most Recent Position	Years Service
Environmental Coordinator	2
Civilian, Environmental Planning Section Chief	2
NCOIC, Base Historian	0.5
Civilian, DPDO Chief	23
Civilian, Superintendent, Sanitation	27
Civilian, Real Property Officer	29
Civilian, Assistant Real Property Officer	23
NCOIC, Grenades	2
NCO, Facility Manager, Munitions	2
Civilian, Munitions Maintenance Operator	4
Civilian, Waste Treatment Plant Operator	14
Civilian, Waste Treatment Plant Operator	9
NCOIC, Waste Treatment Plant	0.5
Civilian, Engineering Technician (Retired)	30
Civilian, Chief of Engineering Construction (Retired)	24
Civilian, Deputy Chief of Operations (Retired)	28
Civilian, Deputy Base Civil Engineer	22
Civilian, Waste Treatment Plant Operator	20
NCO, Facility Manager	2
Civilian, Chief Missile Engineer	11
NCO, Site Manager	5

TABLE B.1
(Continued)
LIST OF INTERVIEWEES

Most Recent Position	Years Service
NCO, Site Manager	2
NCO, Site Manager	3
NCO, Site Manager	0.5
NCO, Facility Manager	3
NCO, Site Manager	8
NCO, Facility Manager	0.5
NCO, Reconcilliator of Site Discrepancies	5
NCOIC, Maintenance Data	20
Civilian, Missile Engineer	6
NCO, Maintenance Data Technician	12
NCO, QC Evaluation	14
NCO, Maintenance Superintendent	0.5
NCO, Maintenance Liaison Force Officer	3.5
NCO, Site Manager	0.5
NCOIC, Fuel Systems	3
Civilian, Missile Water Technician	10
Civilian, Heavy Equipment Maintenance Supervisor	30

TABLE B.2

LIST OF OUTSIDE AGENCIES

Earl Kane, Hydraulic Engineer, Flood Plain Management Section, Kansas City District, U. S. Army Corps of Engineers, 700 Federal Building, 601 East 12th Street, Kansas City, MO 64106. Phone: 816/374-3955. December 12, 1983.

Steve Smith, Supervisor, Knob Noster Water and Wastewater Department, 107 East South Railroad, Knob Noster, MO 65336. Phone: 816/563-2595. December 6, 1983.

Vy Brielefeldt, Planner, Show-Me Regional Planning Commission, P. O. Box 348/College and Culton Streets, Warrensburg, MO 64093. Phone: 816/747-294. December 7, 1983.

Don E. Miller, Senior Scientist, Ground-Water Section, Missouri Division of Geology and Land Survey, P. O. Box 250, Rolla, MO 65401. Phone: 314/364-1752. November 30, 1983.

Leo Emmett, Hydrologist, U. S. Geological Survey - Water Resources Division, Mail Stop 200/1400 Independence Road, Rolla, MO 65401. Phone: 314/341-0824. November 29, 1983.

Paul F. Larson, Soil Scientist U.S. Department of Agriculture, Soil Conservation Service 555 Vandiver Drive Columbia, MO 65201 314/875-5212

Stan Calow, Environmental Engineer Drinking Water Branch U.S. Environmental Protection Agency, Region VII 324 East 11th Street Kansas City, MO 64106 816/374-6514

Richard Locks, Environmental Specialist Missouri Department of Natural Resources, Water Pollution Division. P.O. Box 1368 Jefferson City, MO 65701 314/751-3241

Richard Wehnes, Aquatic Environmental Coordinator Missouri Department of Natural Resources, Division of Environmental Quality P.O. Box 1368 Jefferson City, MO 65101 314/751-4115

APPENDIX C

TENANT MISSIONS - WHITEMAN AFB

APPENDIX C

TENANT MISSIONS - WHITEMAN AFB

1. Air Force Commissary Service, mission is to provide food service to all personnel on base.

2. Detachment 8 - Air Force Institute of Technology, mission is to provide Master in Business Administration programs for launch control officers.

3. 37 Air Rescue and Recovery Squadron, DET 9, mission is to provide the capability for long range, long endurance search and rescue operation. DET 9 has four UH-1F helicopters.

4. Office of Special Investigation, DET 1206, is a special investigative service that provides information on criminal activities and security matters to the Commander, Whiteman AFB, and the Department of the Air Force.

5. Defense Proposal Disposal office, mission is reutilization, transfer and donation of DOD property.

6. Elementary School provides teaching and other educational services to the children of base personnel.

7. Army Aviation Support Facility, Missouri Army National Guard, provides avaiation training for avaiation elements of the Missouri Army National Guard. National Guard operations have 27 helicopters in use on the airfield.

8. Site Activation Task Force (SATAF), DET 31 (AFSC), directs and coordinates all field organizations participating in the programmed alteration of the wing's Minuteman missiles.

9. United Missouri Bank, provides banking and other financial services to base personnel.

10. U.S. Postal Service, provides non-military postal services to the base.

APPENDIX D

SUPPLEMENTAL BASE ENVIRONMENTAL DATA

TABLE D.1

LIST OF PESTICIDES - DECEMBER 1983
WHITEMAN AFB

Malathion 95%
Malathion 57%
Diaznon Powder 2%
Baygon 1%
Rodentcide Pivayl
Malviex
Chlordane 72.0%
Phostoxin
Sodium Cyanide
Guardin Roach Powder
Talon-G
Ficam-W
Diazinon EC
Plyac 75%
Avitnil
Bolt ULD
Cythion ULV
Bolt Roach Baits
Phenotrin 2%
Rodent Cakes
Roach No More
Pyrethrum
Diazinon 2D
Wasp Freeze
Vaponite 2 Oil
Pramitol 25E
Pramitol 5PS
2,4-D Amine
Dursban 10CR

TABLE D.2

SURFACE WATER QUALITY DATA SUMMARY[1]

Parameter, units	Sample Point 003[2]				Sample Point 004				Sample Point 005				Sample Point 006				Sample Point 007				Sample Point 008			
	Max	Min	Avg	No.	Max	Min	Avg	No.	Max	Min	Avg	No.	Max	Min	Avg	No.	Max	Min	Avg	No.	Max	Min	Avg	No.
Chemical Oxygen Demand, mg/l	115	10	21.2	20	250	10	32.4	18	180	10	24.3	15	920	10	102.9	13	82	10	28.6	16	433	10	102.6	14
Total Organic Carbon, mg/l	23	3	11.9	8	23	8	11.3	8	11	5	6.5	8	8	13	12.4	7	28	2	10.5	11	20	8	13.8	9
Oil & Grease, mg/l	10.8	0.2	1.3	20	172.8	0.3	12.04	20	8.6	0.3	1.7	17	11.6	0.3	3.4	14	1900	0.4	71.9	32	1240	0.3	57.6	28
Ammonia as N, mg/l	1.6	0.1	0.3	14	0.3	0.1	0.2	12	1.1	0.1	0.2	12	8.7	8	2.4	12	2200	0.2	159.8	14	26	0.1	3.05	13
Nitrate, mg/l	1.4	0.02	0.3	8	0.7	0.1	0.3	7	0.5	0.02	0.2	5	12.8	0.02	5.5	6	100	0.1	11.2	10	1840	0.02	294.2	8
Nitrite, mg/l	0.05	0.02	0.02	9	0.05	0.02	0.02	9			0.01	8	0.05	0.08	0.05	5	300	0.02	6.3	7	2140	0.02	336	7
Total Kjeldahl N, mg/l				0	0.2	0.2	0.2	4									700	10	355	2	40	0.320	20.2	2
Phosphorous (PO_4), mg/l	0.5	0.1	0.2	6			0.2	4	0.21	0.1	0.1	3	5.4	3.4	3.7	3	1000	0.1	168.4	6	240	0.1	116.8	5
Phosphorous (P), mg/l	0.4	0.1	0.3	8					0.22	0.1	0.2	5	7.5	4.7	5.9	5	1300	0.25	164	8	640	0.01	177.3	7
Phenols, mg/l	170	0.001	19.9	16	20	10	10.7	14	80	10	20.8	15	50	10	17.1	14	140	10	27.2	16	104	10	34.1	20
Arsenic, mg/l	50	0.001	12.9	17	50	10	14.7	18	50	10	15.3	15	50	10	15.7	14	10	10	10	6	2400	10	299.3	14
Cadmium, mg/l	10	0.01	6.9	19	10	10	10	17	1000	10	802	5	10	10	10	14	1600	14	807	2	10	10	10	12
Cyanide, ug/l	0.01	0.01	0.01	5					10	10	10	15					10	10	10	12	1600	700	1010	4
Chromium (Total), ug/l	50	0.01	34.3	19	50	10	47.6	17	50	50	50	15	50	50	50	14	50	50	50	12	50	50	50	13
Chromium (Hexavalent), ug/l	50	0.01	32.4	17	50	50	50	15	50	50	50	15	50	50	50	14	50	50	50	12	50	50	50	12
Copper, ug/l	50	0.02	17.7	16	143	20	37.5	15	210	20	52.8	13	50	20	24.5	12	900	10	101.5	16	[illegible]	20	46.5	13
Lead, ug/l	90	20	632.2	14	2780	50	1263	17	50	20	40	15	2944	136	545.3	13	1500	10	140	14	64	20		13
Manganese, ug/l	3100	50	874.8	5	350	62	214.6	11	310	50	104.7	7	130	2	42.4	8	1800	10	356	9	3070	120	1192	6
Mercury, ug/l	5	1	3.2	11	5	1	3.4	15	5	1	3.1	13	5	1	2.7	12	2100	2	134.7	16	5	1	3.2	13
Nickel, ug/l	165	50	74.4	11	100	50	67.07	15	157	50	80.5	15	171	50	70.8	14	2400	10	236.5	15	164	50	77.3	12
Silver, ug/l	10	10	10	11	10	10	10	15	10	10	10	15	10	10	10	14	10	10	10	15	10	10	10	13
Zinc, ug/l	50	10	46.4	11	64	50	47.7	15	60	10	45.3	15	77	50	54	13	300	10	81.5	16	10	10	10	13
Calcium, mg/l	50	19.4	29.6	3	21.6	16.5	19.2	5	96	27.3	46	6	29.7	22.3	27.6	4	900	10	185.4	6	197	40	68.8	13
Magnesium, mg/l	11.4	8.4	8.7	5	8.5	4.2	6.1	8	15	8.6	11.4	7	21.0	14.9	16.9	6	20.7	10	14.9	8	152	20.4	64.08	6
Potassium, mg/l	7.5	5.0	6.2	5	6.5	3.4	4.9	8	7	3	4.6	8	13.9	5	9.5	7	6.2	4	4.8	8	4.7	3	3.3	7
Sodium, mg/l	101.2	6.8	40.2	5	36.6	8.4	17.8	8	42.3	15.3	33.8	8	97.8	49.5	72.04	7	43	35	40.8	7	123.5	42.2	70.9	6
Boron, ug/l	500	500	500	4	500	500	500	4	500	500	500	5	500	500	500	5	500	500	500	6			500	6
Residue Filtrable (TDS), mg/l	740	148	325.8	9	350	164	235.2	13	650	149	337.7	12	620	210	392.6	12	465	286	343.7	12	985	320	566.7	12
Residue Nonfiltrable (SS), mg/l	58	11	33.5	4	100	3	59.8	7	57	1	14.9	7	37	11	16.5	9	19	4	6	7	15	1	9	6

1. Data summarized generally covered the period 1981-1983, although historical data as early as 1975 were included when available.
2. Max = maximum value
   Min = minimum value
   Avg = average value
   No. = Number of data points

TABLE D.2
(Continued)
SURFACE WATER QUALITY DATA SUMMARY[1]

Parameter, units	Sample Point 003[2]				Sample Point 004				Sample Point 005				Sample Point 006				Sample Point 007				Sample Point 008			
	Max	Min	Avg	No.	Max	Min	Avg	No.	Max	Min	Avg	No.	Max	Min	Avg	No.	Max	Min	Avg	No.	Max	Min	Avg	No.
Specific Conductance, umhos	490	200	360	4	450	185	267	8	800	260	453.7	8	880	490	621.4	7	660	410	437.5	8	1300	670	938.6	6
Sulfate, mg/l	60	0.5	23.4	12	140	12	27.7	15	160	19	63.08	13	110	33	79.7	12	116	11	43.07	14	425	62	158	13
Surfactants, mg/l	0.1	0.5	0.1	12	0.15	0.1	0.1	15	0.5	0.1	0.2	15	0.5	0.1	0.2	13	0.5	0.1	0.2	16	0.5	0.1	0.2	12
Dissolved Oxygen, mg/l	13.5	0.5	6.5	7	15	4	9.05	9	15	8	11.1	10	9	6	7.8	10	14	1	8.5	13	13	3	8.1	10
pH, units	8.8	7.2	7.9	7	8.8	6.7	7.8	9	8.2	7.6	8.03	11	8.6	6.5	8.3	11	8.8	7.4	8	13	8.6	7.0	8	11
Chloride	20	1	11.8	6	56	1	12.3	7	52	4	28	5	40	8	25	4	48	16	34	7	40	16	29.8	6
Beryllium	10	10	10	5	10	10	10	6	10	2.3	8.7	6	17	10	11.7	4	10	10	10	6	10.	10	10	5
Selenium	10	10	10	2	10	10	10	2			10	2	10	10	10	2			10	1				
Barium	1000	1000	1000	8	1000	1000	1000	9													90	82	86	2
Carbon Tetrachloride, ug/l	0.3	0.1	0.2	3	0.3	0.1	0.2	3			0.1	3			0.1	2	0.03	0.1	0.2	5				
Chloromethane, ug/l											0.3	1	0.3	0.1	0.2	2								
Methylene Chloride, ug/l	0.8	0.2	0.3	5	0.8	0.2	0.4	5	0.9	0.2	0.4	8	0.9	0.2	0.5	7	0.7	0.2	0.3	7	0.7	0.2	0.3	7
1,1,2-Tetrachloroethylene, ug/l	0.3	0.1	0.2	4	0.1	0.1	0.1	2	0.3	0.1	0.1	5	0.3	0.1	0.2	3	0.3	0.1	0.2	5	5.5	0.1	1.5	4
1,1,1-Trichloroethane, ug/l	0.3	0.1	0.2	3	0.3	0.1	0.2	4	0.3	0.1	0.1	5	0.6	0.1	0.2	5	0.3	0.1	0.2	7	0.7	0.1	0.3	6
Trichloroethylene, ug/l	0.3	0.1	0.2	3	0.3	0.1	0.2	3	0.3	0.1	0.1	4	0.3	0.1	0.2	4	0.3	0.1	0.2	5	0.3	0.1	0.2	5
PCB's, ug/l											1	1			1	1							1	1
Lindane, ug/l			0.01	1							0.01	1	0.5	0.03	0.2	6			0.01	1	0.05	0.01	0.03	2
p, p'-DDT, ug/l			0.07	1			0.01	1				0.02	1				0.3	0.02	0.2	3				
Diazinon, ug/l	0.3	0.03	0.2	2	0.3	0.03	0.2	2					1.5	0.3	1.2	6	7.5	0.10	2.4	4				
Malathion, ug/l	0.02	0.1	0.05	3	0.1	0.03	0.07	4	0.3	0.1	0.1	4	0.3	0.1	0.1	4					0.1	0.02	0.08	3
Parathion, ug/l									0.9	0.04	0.3	4												
Chlordane, ug/l	0.9	0.2	0.5	2	0.9	0.1	0.4	4			0.4	5	1.6	0.20	0.7	5	.5	0.2	0.3	4	0.8	0.8	0.8	2
alpha-BHC, ug/l											0.07	1												
2, 4-D, ug/l	10	0.05	2.2	5	10	0.05	5.02	4	10	0.06	3.1	7	10	0.06	3.09	7	10	0.05	2.7	4	0.7	0.3	0.5	4
Silvex, ug/l			0.07	1							0.1	1			0.10	1							0.06	2
2,4,5-T, ug/l											0.19	1											0.7	1
Pramitol, ug/l	32	0.02	7.06	8	100	0.09	37.2	10	34	1	11.9	13	64.7	1	17.7	9	210	2.2	37	7	4015	7.5	516.5	9
Dursban (Chloropryfos), ug/l									0.5	0.03	0.1	5	0.4	0.02	0.1	6	0.32	0.02	0.1	4	0.1	0.02	0.04	4
Methylene Chloride, ug/l			0.2	1	0.9	0.4	0.6	2																

1. Data summarized generally covered the period 1981-1983, although historical data as early as 1975 were included when available.
2. Max = maximum value
   Min = minimum value
   Avg = average value
   No. = Number of data points

TABLE D.3
SUMMARY OF SURFACE WATER STANDARDS

Parameters	Standard	Standard Formulator
Oil and Grease	15 mg/l	OEHL of USAF
Phenols	1 ug/l	State of Missouri
Ammonia N	0.1 mg/l	State of Missouri
Iron	1,000 ug/l	State of Missouri
Malathion	0.1 ug/l	State of Missouri
Pramitol	7.5 ug/l	Ciba-Geigy Company

TABLE D.4
POL TANKS AT WHITEMAN AFB

Number	Tank	Contents/Disposition
1	30,000 BBl	Unleaded MOGAS, aboveground
	30,000 BBl	Pickled
2	10,000 BBl	Pickled
3	Off-loading Header	Pickled
4	-	Diesel & fuel, pickled
5	Railroad Tank	Pickled
6	Truck Stand	2 Tanks, pickled
7	-	Used oil, pickled
8	Unloading headers	Pickled
9	Pump station	Pickled
10	JP-4 Stations	Pickled
11	Truck Stands	4 Tanks, 2 in use
12	25,000 Gal	MOGAS
	25,000 Gal	Pickled
	25,000 Gal	Pickled
	25,000 Gal	Diesel
	25,000 Gal	Pickled
13	3,095 BBl	AVGAS Pickled
14	12 X 50,000 Gal	Bldg. 92, JP-4
15	Fueling Outlets	Pickled
16	2 X 10,000 Gal	No. 2 Heating Fuel, Pickled
17	3 X 10,000 Gal	MOGAS (BX Station)
18	3 X 12,000 Gal	MOGAS, Diesel No. 2 and Diesel No. 3
19	Fire Station	-
20	2 X 100,000 Gal	Fuel Oil No. 6, Heating Plant
21	Deleted	
22	Deleted	
23	-	BLDG. 8
24	-	Concrete Pad
25	-	Refueling Maintenance Shop
26	-	Liquid Fuels Maintenance
27	Deleted	
28	Deleted	
29	10 X Hydrants	JP-4
30	Control Pit	JP-4
31	Valve Pit	JP-
32	1,000 Gal	Diesel Tank
33	-	Fuels Management Office
34	Unloading Headers	2 X Inactive
35	Unloading Headers	3 X Inactive
36	-	Base Point of entry, commercial trucks
37	6,000 Gal	-
38	-	Check Point Area
39	-	Contaminate Lube Oil
40	-	LOX Storage Area

NOTE:

1. State capacity of active JP- lines: 26,657 gallons.
2. "Number" refers to numbers assigned on Tab G-7 Drawing, Sheet 1.

Source: Base documents.

APPENDIX E

MASTER LIST OF SHOPS

APPENDIX E
MASTER LIST OF INDUSTRIAL SHOPS
WHITEMAN AFB

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Waste	Current TSD Method
CIVIL ENGINEERING				
Carpenter	705	No	No	--
Entomology	705	Yes	Yes	Applied to ground/refuse.
Fire Department	S-39	Yes	No	--
Golf Course	3078	Yes	No	--
Heat Plant	140	Yes	No	--
Heat Shop	705	Yes	No	--
Interior Electric	705	Yes	No	--
Liquid Fuels Maintenance	93	Yes	Yes	DPDO
Masonry Shop	705	No	No	--
Metal Shop	705	Yes	No	--
Paint Shop	705	Yes	Yes	DPDO/refuse.
Roads and Grounds	T-9	Yes	Yes	O/W Separator/DPDO
Plumbing Shop	705	No	No	--
Power Production	705	Yes	Yes	Neutralized to sanitary sewer/DPDO.
Refrigeration Shop	705	Yes	No	--
Sewage Plant	5034	Yes	No	--

APPENDIX E
(Continued)
MASTER LIST OF INDUSTRIAL SHOPS
WHITEMAN AFB

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Waste	Current TSD Method
CIVIL ENGINEERING (Continued)				
Water Plant	2005	Yes	No	--
Welding Shop	705	No	No	--
Exterior Electric	705	Yes	Yes	DPDO
Fire Extinguisher Refill	S-39	Yes	No	--
COMBAT SUPPORT GROUP				
Auto Hobby Shop	650	Yes	Yes	Contractor/-sanitary sewer
Audiovisual/Photo Lab	1424	Yes	Yes	DPDO/sanitary sewer
Firing Range	1620	Yes	No	--
Reprographics	1425	Yes	No	--
TRANSPORTATION				
Allied Trades	S-159	Yes	Yes	DPDO/refuse.
Vehicle Maintenance	S-159	Yes	Yes	DPDO/Heat Plant.
Heavy Equipment Maintenance	T-9	Yes	Yes	DPDO
Machine Shop	S-159	Yes	No	--

APPENDIX E
(Continued)
MASTER LIST OF INDUSTRIAL SHOPS
WHITEMAN AFB

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Waste	Current TSD Method
TRANSPORTATION (Continued)				
Minor Maint./ Battery Shop	S-159	Yes	Yes	DPDO/neutralized to sanitary sewer.
Packing and Crating	115	No	No	--
Refueling Maintenance	121	Yes	Yes	DPDO
SUPPLY SQUADRON				
Fuels Lab	87	Yes	Yes	Fire Department
351 FMMS				
Corrosion Control	T-30	Yes	Yes	DPDO
Facility Maintenance	S-41	Yes	Yes	DPDO
Mechanical Shop	S-41	No	No	--
Periodic Maintenance Team	T-30	No	No	--
PMEL	S-140	Yes	No	--
Pneudraulics Shop	T-30	No	No	--
Refrigeration Shop	S-43	Yes	Yes	DPDO/sanitary sewer.

APPENDIX E
(Continued)
MASTER LIST OF INDUSTRIAL SHOPS
WHITEMAN AFB

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Waste	Current TSD Method
351 FMMS (Continued)				
Power	S-43	Yes	No	--
Electric/Battery	S-43	Yes	Yes	Neutralized to sanitary sewer.
VECB	S-43	Yes	Yes	DPDO
Re-entry Vehicle	3004	Yes	No	--
351 OMMS				
Electrical Mechanical Team	S-41	Yes	Yes	DPDO
Missile Handling Team	S-41	Yes	No	--
Missile Maintenance Team	S-41	Yes	Yes	DPDO
Transient Maintenance Team	T-9	No	No	--
HOSPITAL				
Dental Clinic	2032	Yes	Yes	DPDO
Dental Lab	2032	Yes	No	--
Dental X-Ray	2032	Yes	Yes	DPDO/sanitary sewer.

APPENDIX E
(Continued)
MASTER LIST OF INDUSTRIAL SHOPS
WHITEMAN AFB

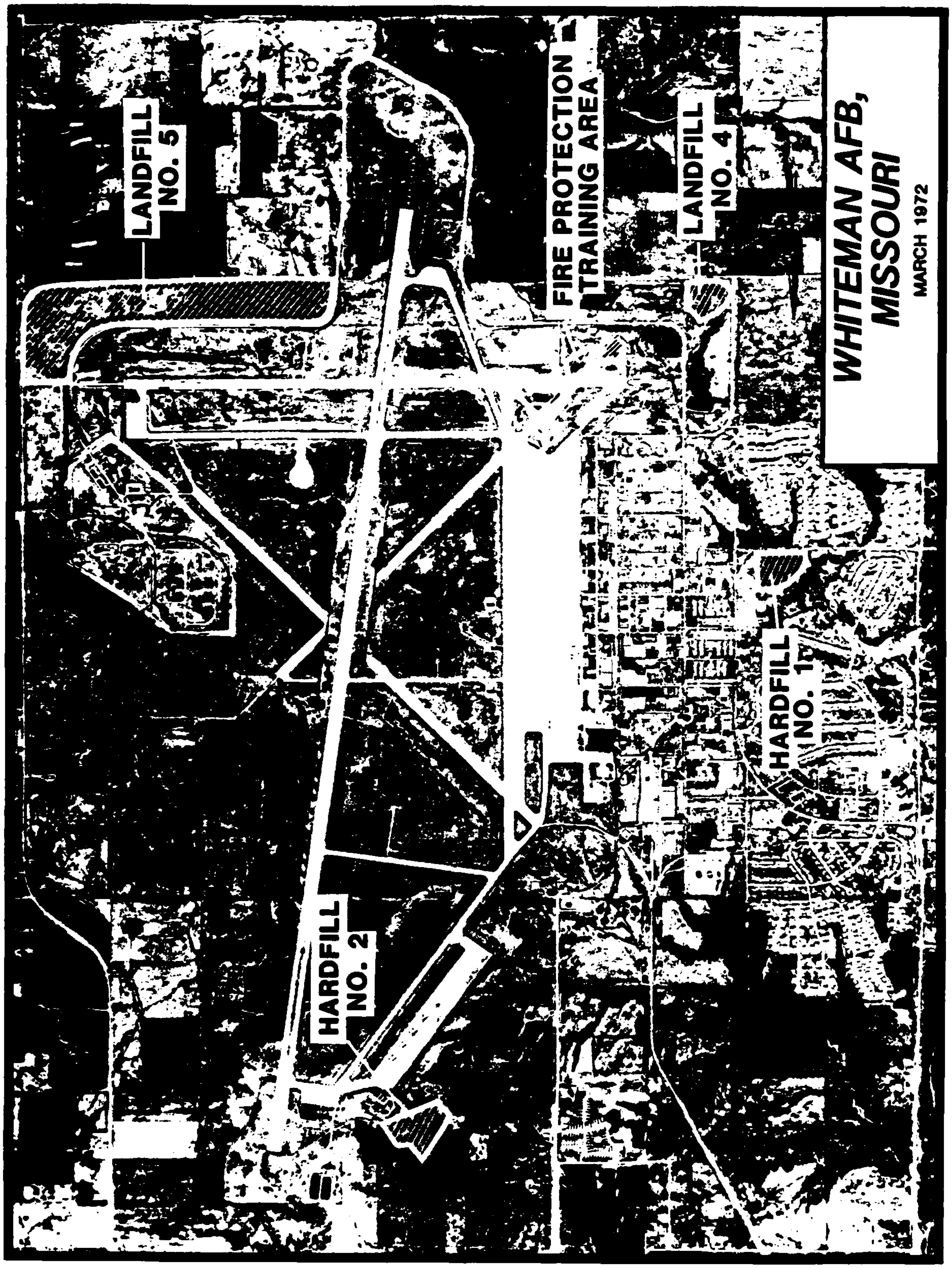
Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Waste	Current TSD Method
HOSPITAL (Continued)				
Medical Lab	2032	Yes	Yes	Autoclave/-sanitary sewer.
Medical Maintenance	2032	Yes	No	--
Medical X-Ray	2032	Yes	Yes	DPDO/sanitary sewer.
2154 COMM SQD				
Teletype Maintenance	S-1426	No	No	--
DSTE	S-1426	Yes	No	--
MCCS	S-53	Yes	No	--
Missile Radio	S-53	Yes	No	--
ATC Radio	S-51	Yes	No	--
Antenna Maintenance	S-59	Yes	No	--
Navigation Aids	S-51	Yes	No	--
Weather Maintenance	S-35	Yes	No	--
HICCS	S-59	No	No	--
SACCS	S-59	Yes	No	--
SATCOM	S-53	YES	No	--
Crypto Maintenance	S-45	No	No	--

APPENDIX E
(Continued)
MASTER LIST OF INDUSTRIAL SHOPS
WHITEMAN AFB

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Waste	Current TSD Method
MO. ARMY NATIONAL GUARD (TENANT)		Yes	Yes	--
37 ARRS DET 9 (TENANT)				
AGE Shop	T-9	Yes	Yes	DPDO/storm drain.
Avionics	T-4	Yes	No	--
Corrosion Control	S-41	Yes	Yes	Refuse.
Helicopter Maintenance	T-4	Yes	Yes	DPDO/Auto Hobby Shop.
Sheet Metal	S-41	No	No	--
Machine Shop	S-41	No	No	--

APPENDIX F

SITE PHOTOGRAPHS


WHITEMAN AFB,
MISSOURI
MARCH 1972
LANDFILL
NO. 5
FIRE PROTECTION
TRAINING AREA
LANDFILL
NO. 4
HARDFILL
NO. 1
HARDFILL
NO. 2

WHITEMAN AFB

FIRE PROTECTION TRAINING AREA

HARDFILL SITE NO. 1

WHITEMAN AFB

LANDFILL NO. 5
(Cont'd)

EASTERN END OF LANDFILL

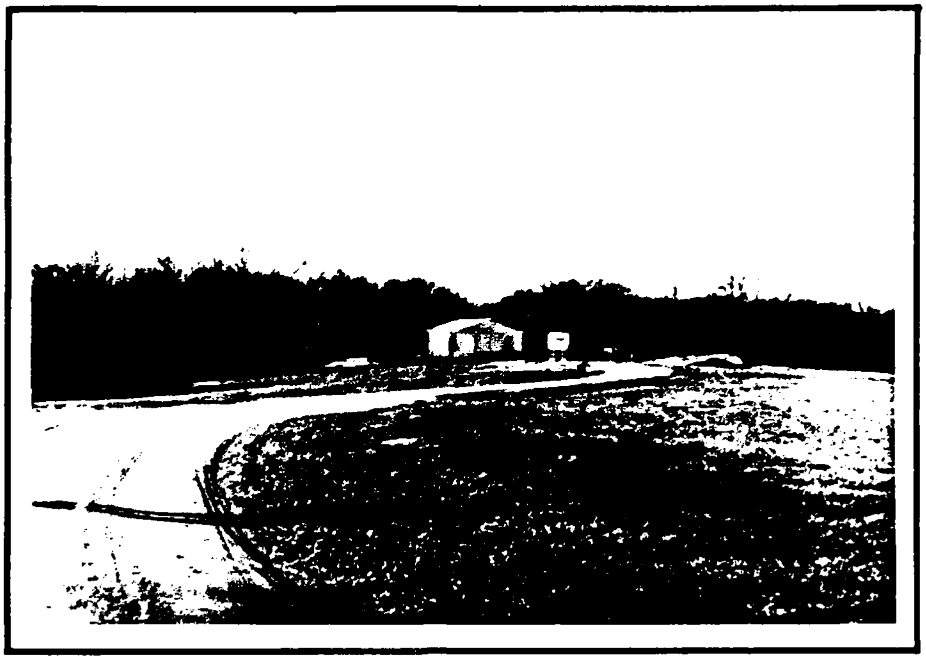
WHITEMAN AFB

LANDFILL NO. 5

LOOKING EAST FROM WEST EDGE

LOOKING SOUTH FROM ACROSS CREEK

WHITEMAN AFB



PESTICIDE STORAGE AREA
(Go!f Course Maintenance)

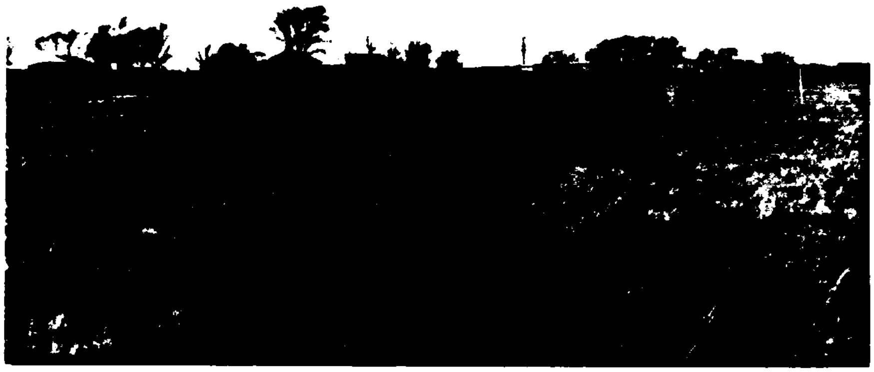
HARDFILL AREA NORTH OF POL

WHITEMAN AFB

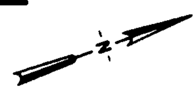
CE STORAGE AREA (Behind Building No. 9)

DPDO HAZARDOUS WASTE STORAGE AREA

WHITEMAN AFB



RADIOACTIVE WASTE STORAGE SITE NO. 2



POL AREA
(Looking Southwest Across Base)

APPENDIX G

USAF INSTALLATION RESTORATION PROGRAM

HAZARD ASSESSMENT RATING METHODOLOGY

APPENDIX G

USAF INSTALLATION RESTORATION PROGRAM

HAZARD ASSESSMENT RATING METHODOLOGY

BACKGROUND

The Department of Defense (DOD) has established a comprehensive program to identify, evaluate, and control problems associated with past disposal practices at DOD facilities. One of the actions required under this program is to:

> "develop and maintain a priority listing of contaminated installations and facilities for remedial action based on potential hazard to public health, welfare, and environmental impacts." (Reference: DEQPPM 81-5, 11 December 1981).

Accordingly, the United States Air Force (USAF) has sought to establish a system to set priorities for taking further actions at sites based upon information gathered during the Records Search phase of its Installation Restoration Program (IRP).

The first site rating model was developed in June 1981 at a meeting with represenatives from USAF Occupational and Environmental Health Laboratory (OEHL), Air Force Engineering and Services Center (AFESC), Engineering-Science (ES) and CH2M Hill. The basis for this model was a system developed for EPA by JRB Associates of McLean, Virginia. The JRB model was modified to meet Air Force needs.

After using this model for 6 months at over 20 Air Force installations, certain inadequacies became apparent. Therefore, on January 26 and 27, 1982, representatives of USAF OEHL, AFESC, various major commands, Engineering-Science, and CH2M Hill met to address the inadequacies. The result of the meeting was a new site rating model designed to present a better picture of the hazards posed by sites at Air Force installations. The new rating model described in this presentation is referred to as the Hazard Assessment Rating Methodology.

PURPOSE

The purpose of the site rating model is to provide a relative ranking of sites of suspected contamination from hazardous substances. This model will assist the Air Force in setting priorities for follow-on site investigations and confirmation work under Phase II of the IRP.

This rating system is used only after it has been determined that (1) potential for contamination exists (hazardous wastes present in sufficient quantity), and (2) potential for migration exists. A site can be deleted from consideration for rating on either basis.

DESCRIPTION OF MODEL

Like the other hazardous waste site ranking models, the U.S. Air Force's site rating model uses a scoring system to rank sites for priority attention. However, in developing this model, the designers incorporated some special features to meet specific DOD program needs.

The model uses data readily obtained during the Records Search portion (Phase I) of the IRP. Scoring judgments and computations are easily made. In assessing the hazards at a given site, the model develops a score based on the most likely routes of contamination and the worst hazards at the site. Sites are given low scores only if there are clearly no hazards at the site. This approach meshes well with the policy for evaluating and setting restrictions on excess DOD properties.

As with the previous model, this model considers four aspects of the hazard posed by a specific site: the possible receptors of the contamination, the waste and its characteristics, potential pathways for waste contaminant migration, and any efforts to contain the contaminants. Each of these categories contains a number of rating factors that are used in the overall hazard rating.

The receptors category rating is calculated by scoring each factor, multiplying by a factor weighting constant and adding the weighted scores to obtain a total category score.

The pathways category rating is based on evidence of contaminant migration or an evaluation of the highest potential (worst case) for contaminant migration along one of three pathways. If evidence of contaminant migration exists, the category is given a subscore of 80 to 100 points. For indirect evidence, 80 points are assigned and for direct evidence, 100 points are assigned. If no evidence is found, the highest score among three possible routes is used. These routes are surface water migration, flooding, and ground-water migration. Evaluation of each route involves factors associated with the particular migration route. The three pathways are evaluated and the highest score among all four of the potential scores is used.

The waste characteristics category is scored in three steps. First, a point rating is assigned based on an assessment of the waste quantity and the hazard (worst case) associated with the site. The level of confidence in the information is also factored into the assessment. Next, the score is multiplied by a waste persistence factor, which acts to reduce the score if the waste is not very persistent. Finally, the score is further modified by the physical state of the waste. Liquid wastes receive the maximum score, while scores for sludges and solids are reduced.

The scores for each of the three categories are then added together and normalized to a maximum possible score of 100. Then the waste management practice category is scored. Sites at which there is no containment are not reduced in score. Scores for sites with limited containment can be reduced by 5 percent. If a site is contained and well managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste management practices category factor to the sum of the scores for the other three categories.

FIGURE 1

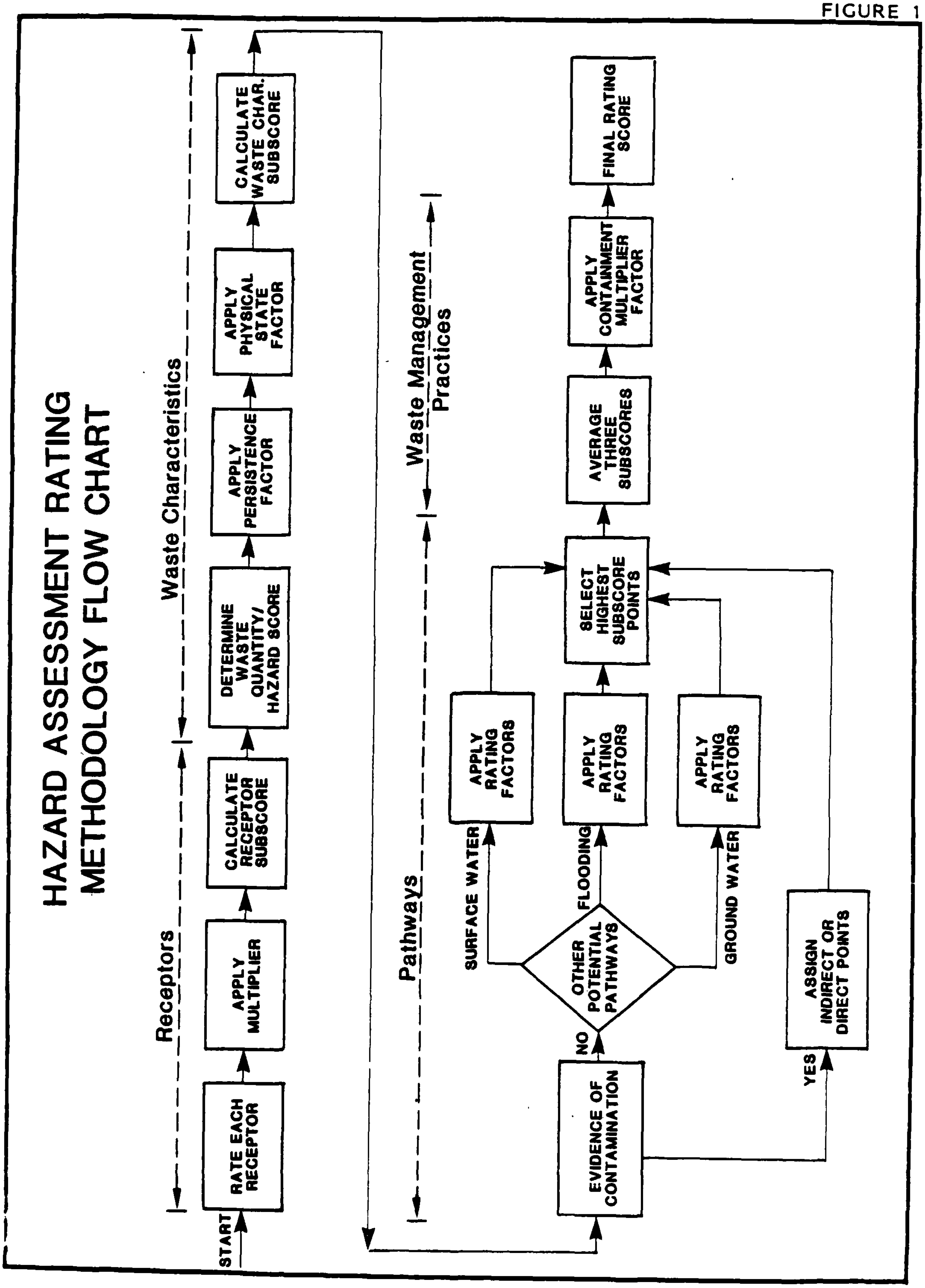

HAZARD ASSESSMENT RATING
METHODOLOGY FLOW CHART
Receptors
Waste Characteristics
Pathways
Waste Management
Practices
START
RATE EACH RECEPTOR
APPLY MULTIPLIER
CALCULATE RECEPTOR SUBSCORE
DETERMINE WASTE QUANTITY/ HAZARD SCORE
APPLY PERSISTENCE FACTOR
APPLY PHYSICAL STATE FACTOR
CALCULATE WASTE CHAR. SUBSCORE
EVIDENCE OF CONTAMINATION
NO
YES
OTHER POTENTIAL PATHWAYS
SURFACE WATER
FLOODING
GROUND WATER
APPLY RATING FACTORS
APPLY RATING FACTORS
APPLY RATING FACTORS
ASSIGN INDIRECT OR DIRECT POINTS
SELECT HIGHEST SUBSCORE POINTS
AVERAGE THREE SUBSCORES
APPLY CONTAINMENT MULTIPLIER FACTOR
FINAL RATING SCORE

FIGURE 2

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE ______

LOCATION ______

DATE OF OPERATION OR OCCURRENCE ______

OWNER/OPERATOR ______

COMMENTS/DESCRIPTION ______

SITE RATED BY ______

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site		4		
B. Distance to nearest well		10		
C. Land use/zoning within 1 mile radius		3		
D. Distance to reservation boundary		6		
E. Critical environments within 1 mile radius of site		10		
F. Water quality of nearest surface water body		6		
G. Ground water use of uppermost aquifer		9		
H. Population served by surface water supply within 3 miles downstream of site		6		
I. Population served by ground-water supply within 3 miles of site		6		
		Subtotals	______	______

Receptors subscore (100 X factor score subtotal/maximum score subtotal) ______

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) ______
2. Confidence level (C = confirmed, S = suspected) ______
3. Hazard rating (H = high, M = medium, L = low) ______

Factor Subscore A (from 20 to 100 based on factor score matrix) ______

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

______ X ______ = ______

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

______ X ______ = ______

FIGURE 2 (Continued)

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore ______

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. Surface water migration				
Distance to nearest surface water		8		
Net precipitation		6		
Surface erosion		8		
Surface permeability		6		
Rainfall intensity		8		
Subtotals			______	______
Subscore (100 X factor score subtotal/maximum score subtotal)				______
2. Flooding		1		
Subscore (100 x factor score/3)				______
3. Ground-water migration				
Depth to ground water		8		
Net precipitation		6		
Soil permeability		3		
Subsurface flows		8		
Direct access to ground water		8		
Subtotals			______	______
Subscore (100 x factor score subtotal/maximum score subtotal)				______

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore ______

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors ______
Waste Characteristics ______
Pathways ______

Total ______ divided by 3 = ______
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

______ X ______ = ______

TABLE 1

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

I. RECEPTORS CATEGORY

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
A. Population within 1,000 feet (includes on-base facilities)	0	1 - 25	26 - 100	Greater than 100	4
B. Distance to nearest water well	Greater than 3 miles	1 to 3 miles	3,001 feet to 1 mile	0 to 3,000 feet	10
C. Land Use/Zoning (within 1 mile radius)	Completely remote (zoning not applicable)	Agricultural	Commercial or industrial	Residential	3
D. Distance to installation boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet	6
E. Critical environments (within 1 mile radius)	Not a critical environment	Natural areas	Pristine natural areas; minor wetlands; preserved areas; presence of economically important natural resources susceptible to contamination.	Major habitat of an endangered or threatened species; presence of recharge area; major wetlands.	10
F. Water quality/use designation of nearest surface water body	Agricultural or industrial use.	Recreation, propagation and management of fish and wildlife.	Shellfish propagation and harvesting.	Potable water supplies	6
G. Ground-Water use of uppermost aquifer	Not used, other sources readily available.	Commercial, industrial, or irrigation, very limited other water sources.	Drinking water, municipal water available.	Drinking water, no municipal water available; commercial, industrial, or irrigation, no other water source available.	9
H. Population served by surface water supplies within 3 miles downstream of site	0	1 - 50	51 - 1,000	Greater than 1,000	6
I. Population served by aquifer supplies within 3 miles of site	0	1 - 50	51 - 1,000	Greater than 1, 000	6

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

II. WASTE CHARACTERISTICS

A-1 Hazardous Waste Quantity

S = Small quantity (<5 tons or 20 drums of liquid)
M = Moderate quantity (5 to 20 tons or 21 to 85 drums of liquid)
L = Large quantity (>20 tons or 85 drums of liquid)

A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)

- o Verbal reports from interviewer (at least 2) or written information from the records.
- o Knowledge of types and quantities of wastes generated by shops and other areas on base.
- o Based on the above, a determination of the types and quantities of waste disposed of at the site.

S = Suspected confidence level

- o No verbal reports or conflicting verbal reports and no written information from the records.
- o Logic based on a knowledge of the types and quantities of hazardous wastes generated at the base, and a history of past waste disposal practices indicate that these wastes were disposed of at a site.

A-3 Hazard Rating

Hazard Category	Rating Scale Levels 0	1	2	3
Toxicity	Sax's Level 0	Sax's Level 1	Sax's Level 2	Sax's Level 3
Ignitability	Flash point greater than 200°F	Flash point at 140°F to 200°F	Flash point at 80°F to 140°F	Flash point less than 80°F
Radioactivity	At or below background levels	1 to 3 times background levels	3 to 5 times background levels	Over 5 times background levels

Use the highest individual rating based on toxicity, ignitability and radioactivity and determine the hazard rating.

Hazard Rating	Points
High (H)	3
Medium (M)	2
Low (L)	1

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

II. WASTE CHARACTERISTICS (Continued)

Waste Characteristics Matrix

Point Rating	Hazardous Waste Quantity	Confidence Level of Information	Hazard Rating
100	L	C	H
80	L	C	M
	M	C	H
70	L	S	H
60	S	C	H
	M	C	M
50	L	S	M
	L	C	L
	M	S	H
	S	C	M
40	S	S	H
	M	S	M
	M	C	L
	L	S	L
30	S	C	L
	M	S	L
	S	S	M
20	S	S	L

Notes:

For a site with more than one hazardous waste, the waste quantities may be added using the following rules:

Confidence Level

- o Confirmed confidence levels (C) can be added
- o Suspected confidence levels (S) can be added
- o Confirmed confidence levels cannot be added with suspected confidence levels

Waste Hazard Rating

- o Wastes with the same hazard rating can be added
- o Wastes with different hazard ratings can only be added in a downgrade mode, e.g., MCM + SCH = LCM if the total quantity is greater than 20 tons.

Example: Several wastes may be present at a site, each having an MCM designation (60 points). By adding the quantities of each waste, the designation may change to LCM (80 points). In this case, the correct point rating for the waste is 80.

B. Persistence Multiplier for Point Rating

Persistence Criteria	Multiply Point Rating From Part A by the Following
Metals, polycyclic compounds, and halogenated hydrocarbons	1.0
Substituted and other ring compounds	0.9
Straight chain hydrocarbons	0.8
Easily biodegradable compounds	0.4

C. Physical State Multiplier

Physical State	Multiply Point Total From Parts A and B by the Following
Liquid	1.0
Sludge	0.75
Solid	0.50

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

III. PATHWAYS CATEGORY

A. Evidence of Contamination

Direct evidence is obtained from laboratory analyses of hazardous contaminants present above natural background levels in surface water, ground water, or air. Evidence should confirm that the source of contamination is the site being evaluated.

Indirect evidence might be from visual observation (i.e., leachate), vegetation stress, sludge deposits, presence of taste and odors in drinking water, or reported discharges that cannot be directly confirmed as resulting from the site, but the site is greatly suspected of being a source of contamination.

B-1 POTENTIAL FOR SURFACE WATER CONTAMINATION

Rating Factor	Rating Scale Levels 0	1	2	3	Multiplier
Distance to nearest surface water (includes drainage ditches and storm sewers)	Greater than 1 mile	2,001 feet to 1 mile	501 feet to 2,000 feet	0 to 500 feet	8
Net precipitation	Less than -10 in.	-10 to + 5 in.	+5 to +20 in.	Greater than +20 in.	6
Surface erosion	None	Slight	Moderate	Severe	8
Surface permeability	0% to 15% clay ($>10^{-2}$ cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	Greater than 50% clay ($<10^{-6}$ cm/sec)	6
Rainfall intensity based on 1 year 24-hr rainfall	<1.0 inch	1.0-2.0 inches	2.1-3.0 inches	>3.0 inches	8
B-2 POTENTIAL FOR FLOODING					
Floodplain	Beyond 100-year floodplain	In 25-year floodplain	In 10-year floodplain	Floods annually	1
B-3 POTENTIAL FOR GROUND-WATER CONTAMINATION					
Depth to ground water	Greater than 500 ft	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 in.	-10 to +5 in.	+5 to +20 in.	Greater than +20 in.	6
Soil permeability	Greater than 50% clay ($>10^{-6}$ cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	0% to 15% clay ($<10^{-2}$ cm/sec)	8
Subsurface flows	Bottom of site greater than 5 feet above high ground-water level	Bottom of site occasionally submerged	Bottom of site frequently submerged	Bottom of site located below mean ground-water level	8
Direct access to ground water (through faults, fractures, faulty well casings, subsidence fissures, etc.)	No evidence of risk	Low risk	Moderate risk	High risk	8

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

IV. WASTE MANAGEMENT PRACTICES CATEGORY

A. This category adjusts the total risk as determined from the receptors, pathways, and waste characteristics categories for waste management practices and engineering controls designed to reduce this risk. The total risk is determined by first averaging the receptors, pathways, and waste characteristics subscores.

B. WASTE MANAGEMENT PRACTICES FACTOR

The following multipliers are then applied to the total risk points (from A):

Waste Management Practice	Multiplier
No containment	1.0
Limited containment	0.95
Fully contained and in full compliance	0.10

Guidelines for fully contained:

Landfills:

- o Clay cap or other impermeable cover
- o Leachate collection system
- o Liners in good condition
- o Adequate monitoring wells

Spills:

- o Quick spill cleanup action taken
- o Contaminated soil removed
- o Soil and/or water samples confirm total cleanup of the spill

Surface Impoundments:

- o Liners in good condition
- o Sound dikes and adequate freeboard
- o Adequate monitoring wells

Fire Proection Training Areas:

- o Concrete surface and berms
- o Oil/water separator for pretreatment of runoff
- o Effluent from oil/water separator to treatment plant

General Note: If data are not available or known to be complete the factor ratings under items I-A through I, III-B-1 or III-B-3, then leave blank for calculation of factor score and maximum possible score.

APPENDIX H

SITE ASSESSMENT RATING FORMS

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Chlordane Application Areas
Location: Housing Areas
Date of Operation or Occurence: 1980 - Present
Owner/Operator: Whiteman AFB
Comments/Description: Contaminants reported to infiltrate surface waters. Industrial and residential sections of the base
Site Rated by: E. H. Snider, J. R. Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest water well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			130	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 72

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 0.90 = 54

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

54 x 1.00 = 54

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	1	6	6	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			74	108
Subscore (100 x factor score subtotal/maximum score subtotal)				69
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			22	114
Subscore (100 x factor score subtotal/maximum score subtotal)				19

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 69

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	72
Waste Characteristics	54
Pathways	69
Total 195 divided by 3 =	65 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

65 x 1.00 = 65

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Fire Protection Training Area
Location: South of old, unused Runway
Date of Operation or Occurence: 1940's - present
Owner/Operator: Whiteman AFB
Comments/Description: This is the only fire training area on base

Site Rated by: E. H. Snider, R. J. Reimer and J. R. Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest water well	2	10	20	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to installation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	2	6	12	18
Subtotals			80	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 44

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 2
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 80

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

80 x 0.80 = 54

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

54 x 1.00 = 54

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	1	6	6	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			58	108
Subscore (100 x factor score subtotal/maximum score subtotal)				54
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			22	114
Subscore (100 x factor score subtotal/maximum score subtotal)				19

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 80

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		44
Waste Characteristics		64
Pathways		80
Total	188 divided by 3 =	63 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

63 x 1.00 = 63

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Landfill No. 5
Location: South edge of base, southeast corner
Date of Operation or Occurence: 1972 - 1978
Owner/Operator: Whiteman AFB
Comments/Description: Base refuse along with drums of waste; some drums have been removed.

Site Rated by: E. H. Snider, R. J. Reimer and J. R. Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest water well	3	10	30	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	2	6	12	18
Subtotals			100	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 56

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 2
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 80

B. Apply persistance factor
Factor Subscore A x Persistance Factor = Subscore B

80 x 0.90 = 72

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

72 x 1.00 = 72

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	1	6	6	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			74	108
Subscore (100 x factor score subtotal/maximum score subtotal)				69
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			38	114
Subscore (100 x factor score subtotal/maximum score subtotal)				33

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 69

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		56	
Waste Characteristics		72	
Pathways		69	
Total	197	divided by 3 =	66 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

66 x 0.95 = 62

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Pesticide Disposal Area
Location: Inside dike of POL Bulk Storage Area
Date of Operation or Occurence: ? - present
Owner/Operator: Whiteman AFB
Comments/Description: Rinsate from pesticide can washing along with leftover excess pesticide, has been poured out onto the ground.
Site Rated by: E. H. Snider, R. J. Reimer and J. R. Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest water well	3	10	30	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			102	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 57

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 1.00 = 60

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.00 = 60

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	1	6	6	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			66	108
Subscore (100 x factor score subtotal/maximum score subtotal)				61
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			22	114
Subscore (100 x factor score subtotal/maximum score subtotal)				19

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 61

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		57
Waste Characteristics		60
Pathways		61
Total	178 divided by 3 =	59 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

59 x 1.00 = 59

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Sodium Chromate Treatment Area - STP
Location: West edge of base at old Sewage Treatment Plant
Date of Operation or Occurence: 1981 - 1982
Owner/Operator: Whiteman AFB
Comments/Description: Small spills during Reduction Process.

Site Rated by: E. H. Snider, R. J. Reimer and J. R. Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest water well	3	10	30	30
C. Land use/zoning within 1 mile radius	0	3	0	9
D. Distance to installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			99	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 55

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 1.00 = 60

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.00 = 60

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	1	6	6	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			58	108
Subscore (100 x factor score subtotal/maximum score subtotal)				54
2. Flooding	. 0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			22	114
Subscore (100 x factor score subtotal/maximum score subtotal)				19

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 54

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	55		
Waste Characteristics	60		
Pathways	54		
Total 169	divided by 3 =	56	Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

56 x 1.00 = 56

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Drum Storage Area at Building T-9
Location: East of T-9
Date of Operation or Occurence:
Owner/Operator: Whiteman AFB
Comments/Description: Surface contamination noted; storm drain nearby.

Site Rated by: E. H. Snider, J. R. Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest water well	3	10	30	30
C. Land use/zoning within 1 mile radius	0	3	0	9
D. Distance to installation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	0	9	0	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			66	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 37

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 0.90 = 54

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

54 x 1.00 = 54

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	1	6	6	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			66	108
Subscore (100 x factor score subtotal/maximum score subtotal)				61
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			22	114
Subscore (100 x factor score subtotal/maximum score subtotal)				19

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 61

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		37
Waste Characteristics		54
Pathways		61
Total	152 divided by 3 =	51 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

51 x 1.00 = 51

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Storm Water Drainage from Aircraft Wash Rack
Location: Corner of Operations Apron
Date of Operation or Occurence: 1950's - 1960's
Owner/Operator: Whiteman AFB
Comments/Description: Cleaning solvents used at wash rack discharged to storm water system

Site Rated by: E. H. Snider, R. J. Reimer and J. R. Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest water well	3	10	30	30
C. Land use/zoning within 1 mile radius	0	3	0	9
D. Distance to installation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			93	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 52

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 0.40 = 24

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

24 x 1.00 = 24

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	1	6	6	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			66	108
Subscore (100 x factor score subtotal/maximum score subtotal)				61
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			22	114
Subscore (100 x factor score subtotal/maximum score subtotal)				19

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 61

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		52
Waste Characteristics		24
Pathways		61
Total	137 divided by 3 =	46 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

46 x 1.00 = 46

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Landfill No. 1
Location: POL Bulk Storage Tanks
Date of Operation or Occurence: 1940's
Owner/Operator: Whiteman AFB
Comments/Description: Used for disposal of base refuse and old glider parts

Site Rated by: E. H. Snider, R. J. Reimer and J. R. Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest water well	3	10	30	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			102	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 57

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 1

Factor Subscore A (from 20 to 100 based on factor score matrix) 30

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

30 x 0.90 = 27

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

27 x 0.50 = 14

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	1	6	6	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			66	108
Subscore (100 x factor score subtotal/maximum score subtotal)				61
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			22	114
Subscore (100 x factor score subtotal/maximum score subtotal)				19

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 61

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	57
Waste Characteristics	14
Pathways	61
Total 131 divided by 3 =	44 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

44 x 0.95 = 42

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Low Level Radioactive Disposal Area No. 1
Location: West part of base near North Barksdale Road
Date of Operation or Occurence: Early to mid-1950's
Owner/Operator: Whiteman AFB
Comments/Description: Excavated in 1957 and placed in Low Level Radioactive Site No.2. Discrepancy indicates some material may remain.
Site Rated by: E. H. Snider, R. J. Reimer and J. R. Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest water well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to installation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			106	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 59

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 2
3. Hazard rating (1=low, 2=medium, 3=high) 1

Factor Subscore A (from 20 to 100 based on factor score matrix) 20

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

20 x 1.00 = 20

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

20 x 0.50 = 10

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	1	6	6	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			66	108
Subscore (100 x factor score subtotal/maximum score subtotal)				61
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			22	114
Subscore (100 x factor score subtotal/maximum score subtotal)				19

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 61

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		59
Waste Characteristics		10
Pathways		61
Total	130 divided by 3 =	43 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

43 x 0.95 = 41

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Landfill No. 2
Location: South edge of base
Date of Operation or Occurence: 1950's
Owner/Operator: Whiteman AFB
Comments/Description: Trench and fill refuse operation

Site Rated by: E. H. Snider, R. J. Reimer and J. R. Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest water well	2	10	20	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to installation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	2	6	12	18
Subtotals			80	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 44

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 1

Factor Subscore A (from 20 to 100 based on factor score matrix) 30

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

30 x 0.90 = 27

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

27 x 0.50 = 14

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	1	6	6	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			58	108
Subscore (100 x factor score subtotal/maximum score subtotal)				54
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			22	114
Subscore (100 x factor score subtotal/maximum score subtotal)				19

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 54

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		44
Waste Characteristics		14
Pathways		54
Total	112 divided by 3 =	37 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

37 x 0.95 = 35

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Landfill No. 3
Location: South edge of base
Date of Operation or Occurence: 1940's to mid-1950's
Owner/Operator: Whiteman AFB
Comments/Description: Trench and fill refuse operation

Site Rated by: E. H. Snider, R. J. Reimer and J. R. Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest water well	2	10	20	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to installation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	2	6	12	18
Subtotals			80	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 44

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 2
3. Hazard rating (1=low, 2=medium, 3=high) 1

Factor Subscore A (from 20 to 100 based on factor score matrix) 20

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

20 x 0.90 = 18

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

18 x 0.50 = 9

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	1	6	6	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			58	108
Subscore (100 x factor score subtotal/maximum score subtotal)				54
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			22	114
Subscore (100 x factor score subtotal/maximum score subtotal)				19

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 54

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		44	
Waste Characteristics		9	
Pathways		54	
Total	107 divided by 3 =		36 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

36 x 0.95 = 34

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Landfill No. 4
Location: South edge of base
Date of Operation or Occurence: 1957 - 1958
Owner/Operator: Whiteman AFB
Comments/Description: Trench and fill refuse operation

Site Rated by: E. H. Snider, R. J. Reimer and J. R. Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest water well	2	10	20	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to installation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	2	6	12	18
Subtotals			80	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 44

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 2
3. Hazard rating (1=low, 2=medium, 3=high) 1

Factor Subscore A (from 20 to 100 based on factor score matrix) 20

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

20 x 0.90 = 18

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

18 x 0.50 = 9

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	1	6	6	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			58	108
Subscore (100 x factor score subtotal/maximum score subtotal)				54
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			22	114
Subscore (100 x factor score subtotal/maximum score subtotal)				19

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 54

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		44
Waste Characteristics		9
Pathways		54
Total	107	divided by 3 = 36 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

36 x 0.95 = 34

APPENDIX I

REFERENCES

APPENDIX I

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APPENDIX J

GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

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GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

ABG: Air Base Group

ACFT MAINT: Aircraft Maintenance.

AF: Air Force.

AFB: Air Force Base.

AFESC: Air Force Engineering and Services Center.

AFFF: Aqueous Film Forming Foam, a fire extinguishing agent.

AFR: Air Force Regulation.

Ag: Chemical symbol for silver.

AGE: Aerospace Ground Equipment.

Al: Chemical symbol for aluminum.

ALLUVIUM: Materials eroded, transported and deposited by streams.

ALLUVIAL FAN: A fan-shaped deposit formed by a stream either where it issues from a narrow mountain valley into a plain or broad valley, or where a tributary stream joins a main stream.

ANTICLINE: A fold in which layered strata are inclined down and away from the axes.

AQUAZENE: an algicide.

ARRS: Aerospace Rescue and Recovery Squadron.

ARTESIAN: Ground water contained under hydrostatic pressure.

AQUIFER: A geologic formation, group of formations, or part of a formation that is capable of yielding water to a well or spring.

AROMATIC: Description of organic chemical compounds in which the carbon atoms are arranged into a ring with special electron stability associated. Aromatic compounds are often more reactive than non-aromatics.

ATC: Air Training Command.

AVGAS: Aviation Gasoline.

Ba: Chemical symbol for barium.

BEE: Bioenvironmental Engineer.

BES: Bioenvironmental Engineering Services

BIOACCUMULATE: Tendency of elements or compounds to accumulate or build up in the tissues of living organisms when they are exposed to these elements in their environments, e.g., heavy metals.

BIODEGRADABLE: The characteristic of a substance to be broken down from complex to simple compounds by microorganisms.

BOWSER: A portable tank, usually under 200 gallons in capacity.

BX: Base Exchange.

$CaCO_3$: Chemical symbol for calcium carbonate.

CAMS: Consolidated Aircraft Maintenance Squadron.

Cd: Chemical symbol for cadmium.

CE: Civil Engineering.

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act.

CES: Civil Engineering Squadron.

CIRCA: About; used to indicate an approximate date.

CLOSURE: The completion of a set of rigidly defined functions for a hazardous waste facility no longer in operation.

CN: Chemical symbol for cyanide.

COD: Chemical Oxygen Demand, a measure of the amount of oxygen required to oxidize organic and oxidizable inorganic compounds in water.

COE: Corps of Engineers.

CONFINED AQUIFER: An aquifer bounded above and below by impermeable strata or by geologic units of distinctly lower permeability than that of the aquifer itself.

CONFINING UNIT: A geologic unit with low permeability which restricts the movement of ground water.

CONTAMINATION: The degradation of natural water quality to the extent that its usefulness is impaired; there is no implication of any specific limits since the degree of permissible contamination depends upon the intended end use or uses of the water.

Cr: Chemical symbol for chromium.

CS: Communications Squadron.

CSG: Combat Support Group.

Cu: Chemical symbol for copper.

DCM: Deputy Commander for Maintenance.

DCO: Deputy Commander for Operations.

DCRM: Deputy Commander for Resource Management.

DEQPPM: Defense Environmental Quality Program Policy Memorandum

DET: Detachment.

DIP: The angle at which a stratum is inclined from the horizontal.

DISPOSAL FACILITY: A facility or part of a facility at which hazardous waste is intentionally placed into or on land or water, and at which waste will remain after closure.

DISPOSAL OF HAZARDOUS WASTE: The discharge, deposit, injection, dumping, spilling, or placing of any hazardous waste into or on land or water so that such waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground water.

DOD: Department of Defense.

DOT: Department of Transportation

DOWNGRADIENT: In the direction of decreasing hydraulic static head; the direction in which ground water flows.

DPDO: Defense Property Disposal Office, previously included Redistribution and Marketing (R&M) and Salvage.

DUMP: An uncovered land disposal site where solid and/or liquid wastes are deposited with little or no regard for pollution control or aesthetics; dumps are susceptible to open burning and are exposed to the elements, disease vectors and scavengers.

EFFLUENT: A liquid waste discharge from a manufacturing or treatment process, in its natural state, or partially or completely treated, that discharges into the environment.

EOD: Explosive ordnance disposal.

EP: Extraction Procedure, the EPA's standard laboratory procedure for leachate generation.

EPA: U.S. Environmental Protection Agency.

EPHEMERAL AQUIFER: A water-bearing zone typically located near the surface which normally contains water seasonally.

EROSION: The wearing away of land surface by wind, water, or chemical processes.

ES: Engineering-Science, Inc.

ETHYLENE GLYCOL: A liquid used for de-icing aircraft; it bioaccumulates and can exhibit toxic properties.

FAA: Federal Aviation Administration.

FACILITY: Any land and appurtenances thereon and thereto used for the treatment, storage and/or disposal of hazardous wastes.

FAULT: A fracture in rock along which the adjacent rock surfaces are differentially displaced.

Fe: Chemical symbol for iron.

FLOOD PLAIN: The lowland and relatively flat areas adjoining inland and coastal areas of the mainland and off-shore islands, including, at a minimum, areas subject to a one percent or greater chance of flooding in any given year.

FLOW PATH: The direction or movement of ground water as governed principally by the hydraulic gradient.

FPTA: Fire Protection Training Area.

FTW: Flying Training Wing

FY: Fiscal Year

GC/MS: Gas chromatograph/mass spectrophotometer, a laboratory procedure for identifying unknown organic compounds.

GROUND WATER: Water beneath the land surface in the saturated zone that is under atmospheric or artesian pressure.

GROUND-WATER RESERVOIR: The earth materials and the intervening open spaces that contain ground water.

HALON: A fluorocarbon fire extinguishing compound.

HALOGEN: The class of chemical elements including fluorine, chlorine, bromine, and iodine.

HARDFILL: Disposal sites receiving construction debris, wood, miscellaneous spoil material.

HARM: Hazard Assessment Rating Methodology.

HAZARDOUS SUBSTANCE: Under CERCLA, the definition of hazardous substance includes:

1. All substances regulated under Paragraphs 311 and 307 of the Clean Water Act (except oil);

2. All substances regulated under Paragraph 3001 of the Solid Waste Disposal Act;

3. All substances regulated under Paragraph 112 of the Clean Air Act;

4. All substances which the Administrator of EPA has acted against under Paragraph 7 of the Toxic Substance Control Act;

5. Additional substances designated under Paragraph 102 of the Superfund bill.

HAZARDOUS WASTE: As defined in RCRA, a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

HAZARDOUS WASTE GENERATION: The act or process of producing a hazardous waste.

HEAVY METALS: Metallic elements, including the transition series, which include many elements required for plant and animal nutrition in trace concentrations but which become toxic at higher concentrations.

Hg: Chemical symbol for mercury.

HQ: Headquarters.

HWAP: Hazardous Waste Accumulation Point

HWMF: Hazardous Waste Management Facility.

HYDROCARBONS: Organic chemical compounds composed of hydrogen and carbon atoms chemically bonded. Hydrocarbons may be straight chain, cyclic, branched chain, aromatic, or polycyclic, depending upon arrangement of carbon atoms. Halogenated hydrocarbons are hydrocarbons in which one or more hydrogen atoms has been replaced by a halogen atom.

INCOMPATIBLE WASTE: A waste unsuitable for commingling with another waste or material because the commingling might result in generation of extreme heat or pressure, explosion or violent reaction, fire, formation of substances which are shock sensitive, friction sensitive, or otherwise have the potential for reacting violently, formation of toxic dusts, mists, fumes, and gases, volatilization of ignitable or toxic chemicals due to heat generation in such a manner that the likelihood of contamination of ground water or escape of the substance into the environment is increased, any other reaction which might result in not meeting the air, human health, and environmental standards.

ICBM: Intercontinental Ballistic Missile

ILS: Instrument Landing System

INFILTRATION: The movement of water through the soil surface into the ground.

IRP: Installation Restoration Program.

ISOPACH: Graphic presentation of geologic data, including lines of equal unit thickness that may be based on confirmed (drill hole) data or indirect geophysical measurement.

ISOPROPYL ALCOHOL: Flammable liquid used for cleaning small parts.

JP-4: Jet Propulsion Fuel Number Four, military jet fuel.

KOH: Chemical symbol for potassium hydroxide.

LCF: Launch Control Facility.

LEACHATE: A solution resulting from the separation or dissolving of soluble or particulate constituents from solid waste or other man-placed medium by percolation of water.

LEACHING: The process by which soluble materials in the soil, such as nutrients, pesticide chemicals or contaminants, are washed into a lower layer of soil or are dissolved and carried away by water.

LENTICULAR: A bed or rock stratum or body that is lens-shaped.

LF: Launch Facility.

LINER: A continous layer of natural or man-made materials beneath or on the sides of a surface impoundment, landfill, or landfill cell which restricts the downward or lateral escape of hazardous waste, hazardous waste constituents or leachate.

LITHOLOGY: The description of the physical character of a rock.

LOESS: An essentially unconsolidated unstratified calcareous silt; commonly homogeneous, permeable and buff to gray in color.

LYSIMETER: A vacuum operated sampling device used for extracting pore water samples at various depths within the unsaturated zone.

MAC: Military Airlift Command.

MEK: Methyl Ethyl Ketone.

MERCURY AMALGAM: A solid used in dental work; contains the toxic metal mercury.

METALS: See "Heavy Metals".

MGD: Million gallons per day.

MOA: Military Operating Area.

MIK: Methyl isobutyl ketone.

MOGAS: Motor gasoline.

Mn: Chemical symbol for manganese.

MODIFIED MERCALLI INTENSITY: A number describing the effects of an earthquake on man, structures and the earth's surface. A Modified Mercalli Intensity of I is not felt. An intensity of VI is felt indoors and outdoors and for an intensity of VII it becomes difficult for a man to remain standing. Intensities of IX to XII involve increasing levels of destruction with destruction being nearly total at an intensity of XII.

MONITORING WELL: A well used to measure ground-water levels and to obtain samples.

MSL: Mean Sea Level.

MSS: Missile Security Squadron.

MWR: Morale, Welfare and Recreation.

NCO: Non-commissioned Officer.

NCOIC: Non-commissioned Officer In-Charge.

NDI: Non-destructive inspection.

NET PRECIPITATION: The amount of annual precipitation minus annual evaporation.

NGVD: National Geodetic Vertical Datum of 1929.

Ni: Chemical symbol for nickel.

NOAA: National Oceanic and Atmospheric Administration

NPDES: National Pollutant Discharge Elimination System.

OEHL: Occupational and Environmental Health Laboratory.

OIC: Officer-In-Charge.

OMMS: Organization Missile Maintenance Squadron.

ORGANIC: Being, containing or relating to carbon compounds, especially in which hydrogen is attached to carbon.

OSI: Office of Special Investigations.

O&G: Symbols for oil and grease.

Pb: Chemical symbol for lead.

PCB: Polychlorinated Biphenyl; liquids used as a dielectrics in electrical equipment.

PERCOLATION: Movement of moisture by gravity or hydrostatic pressure through interstices of unsaturated rock or soil.

PERMEABILITY: The capacity of a porous rock, soil or sediment for transmitting a fluid without damage to the structure of the medium.

PERSISTENCE: As applied to chemicals, those which are very stable and remain in the environment in their original form for an extended period of time.

PD-680: Cleaning solvent.

pH: Negative logarithm of hydrogen ion concentration.

PL: Public Law.

POL: Petroleum, Oils and Lubricants.

POLLUTANT: Any introduced gas, liquid or solid that makes a resource unfit for a specific purpose.

POLYCYCLIC COMPOUND: All compounds in which carbon atoms are arranged into two or more rings, usually aromatic in nature.

POTASSIUM HYDROXIDE: Corrosive material, usually liquid, used for cleaning purposes.

POTENTIALLY ACTIVE FAULT: A fault along which movement has occurred within the last 25-million years.

POTENTIOMETRIC SURFACE: The surface to which water in an aquifer would rise in tightly cased wells open only to the aquifer.

PPB: Parts per billion by weight.

PPM: Parts per million by weight.

PRAMITOL: Herbicide.

PRECIPITATION: Rainfall.

PURPLE K: A bicarbonate-based fire extinguishing agent.

QUATERNARY MATERIALS: The second period of the Cenozoic geologic era, following the Tertiary, and including the last 2-3 million years.

RCRA: Resource Conservation and Recovery Act.

RECEPTORS: The potential impact group or resource for a waste contamination source.

RECHARGE AREA: A surface area in which surface water or precipitation percolates through the unsaturated zone and eventually reaches the zone of saturation. Recharge areas may be natural or manmade.

RECHARGE: The addition of water to the ground-water system by natural or artificial processes.

RIPARIAN: Living or located on a riverbank.

SAC: Strategic Air Command.

SANITARY LANDFILL: A land disposal site using an engineered method of disposing solid wastes on land in a way that minimizes environmental hazards.

SATURATED ZONE: That part of the earth's crust in which all voids are filled with water.

SATAF: Site Activation Task Force.

SAX'S TOXICITY: A rating method for evaluating the toxicity of chemical materials.

SCS: U.S. Department of Agriculture Soil Conservation Service.

SEISMICITY: Pertaining to earthquakes or earth vibrations.

SLUDGE: Any garbage, refuse, or slude from a waste treatment plant, water supply treatment, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, or agricultural operations and from community activities, but does not include solid or dissolved materials in domestic sewage; solid or dissolved materials in irrigation return flows; industrial discharges which are point source subject to permits under Section 402 of the Federal Water Pollution Control Act, as amended (86 USC 880); or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954 (68 USC 923).

SMS: Strategic Missile Squadron.

SMW: Strategic Missile Wing.

SODIUM CHROMATE: Liquid used in refrigeration/air conditioning machines, contains toxic chromium.

SOLID WASTE: Any garbage, refuse, or sludge from a waste treatment plant, water supply treatment, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, or agricultural operations and from community activities, but does not include solid or dissolved materials in domestic sewage; solid or dissolved materials in irrigation return flows; industrial discharges which are point source subject to permits under Section 402 of the Federal Water Pollution Control Act, as amended (86 USC 880); or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954 (68 USC 923).

SPG: Security Police Group.

SPILL: Any unplanned release or discharge of a hazardous waste onto or into the air, land, or water.

SPS: Security Police Squadron.

STORAGE OF HAZARDOUS WASTE: Containment, either on a temporary basis or for a longer period, in such a manner as not to constitute disposal of such hazardous waste.

STP: Sewage Treatment Plant.

SUPS: Supply Squadron.

SVS: Services Squadron.

TCE: Trichloroethylene.

TCHTW: Technical Training Wing

TDS: Total Dissolved Solids, a water quality parameter.

TOC: Total Organic Carbon.

TOXICITY: The ability of a material to produce injury or disease upon exposure, ingestion, inhalation, or assimilation by a living organism.

TRANSMISSIVITY: The rate at which water is transmitted through a unit width of aquifer under a unit hydraulic gradient.

TREATMENT OF HAZARDOUS WASTE: Any method, technique, or process including neutralization designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize the waste or so as to render the waste nonhazardous.

TRNS: Transportation Squadron.

TSD: Treatment, storage or disposal.

TSDF: Treatment, storage or disposal facility.

TTG: Technical Training Group.

TVOR: Tactical Very-high-frequency Omnidirectional Range, a ground-based radio transmitter for aircraft navigation.

UPGRADIENT: In the direction of increasing hydraulic static head; the direction opposite to the prevailing flow of ground water.

UREA: Solid, toxic in high doses, used as a combination ground de-icer and fertilizer.

USAF: United States Air Force.

USAFSS: United States Air Force Security Service.

USDA: United States Department of Agriculture.

USFWS: United States Fish and Wildlife Service.

USGS: United States Geological Survey.

WATERFALL: A device in a paint spray booth which removes excess spray paint from the air.

WATER TABLE: Surface of a body of unconfined ground water at which the pressure is equal to that of the atmosphere.

WWTP: Wastewater Treatment Plant.

Zn: Chemical symbol for zinc.

APPENDIX K

INDEX OF SITES OF POTENTIAL ENVIRONMENTAL CONTAMINATION

APPENDIX K
INDEX OF REFERENCES TO POTENTIAL CONTAMINATION SITES AT WHITEMAN AFB

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